New Junior Encyclopedia

Vol 3

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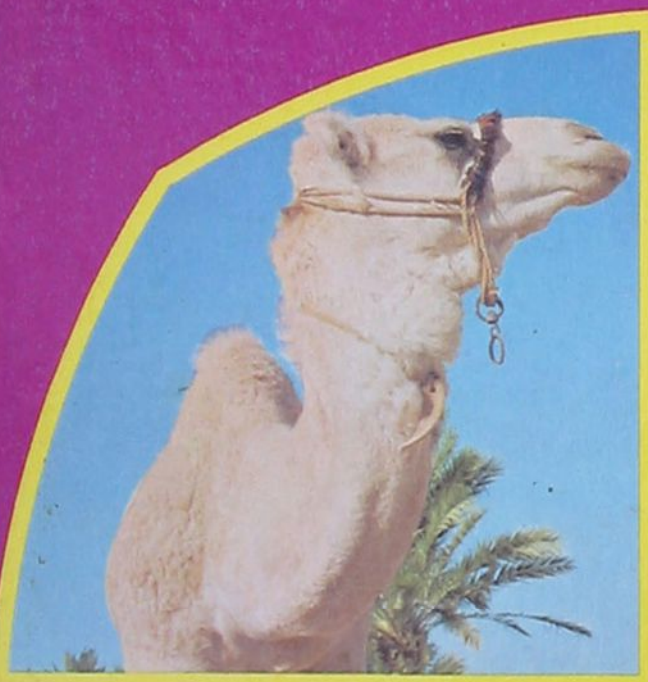

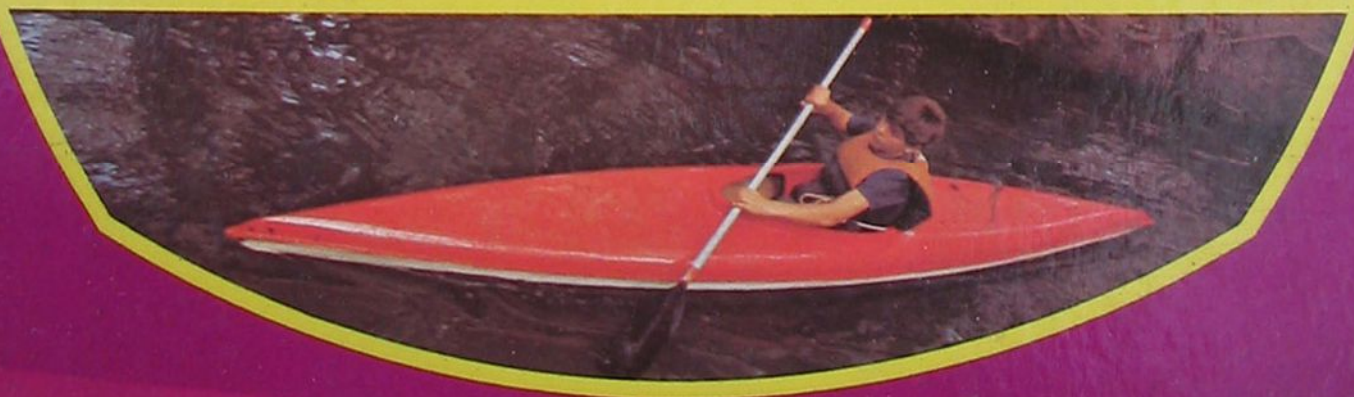

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City Magazines, 1-3 Wine Office Court, Fleet Street, London.
Distributed in Australia and New Zealand by
Bay Books (Pty) Ltd, Sydney.
Made and printed in Great Britain by
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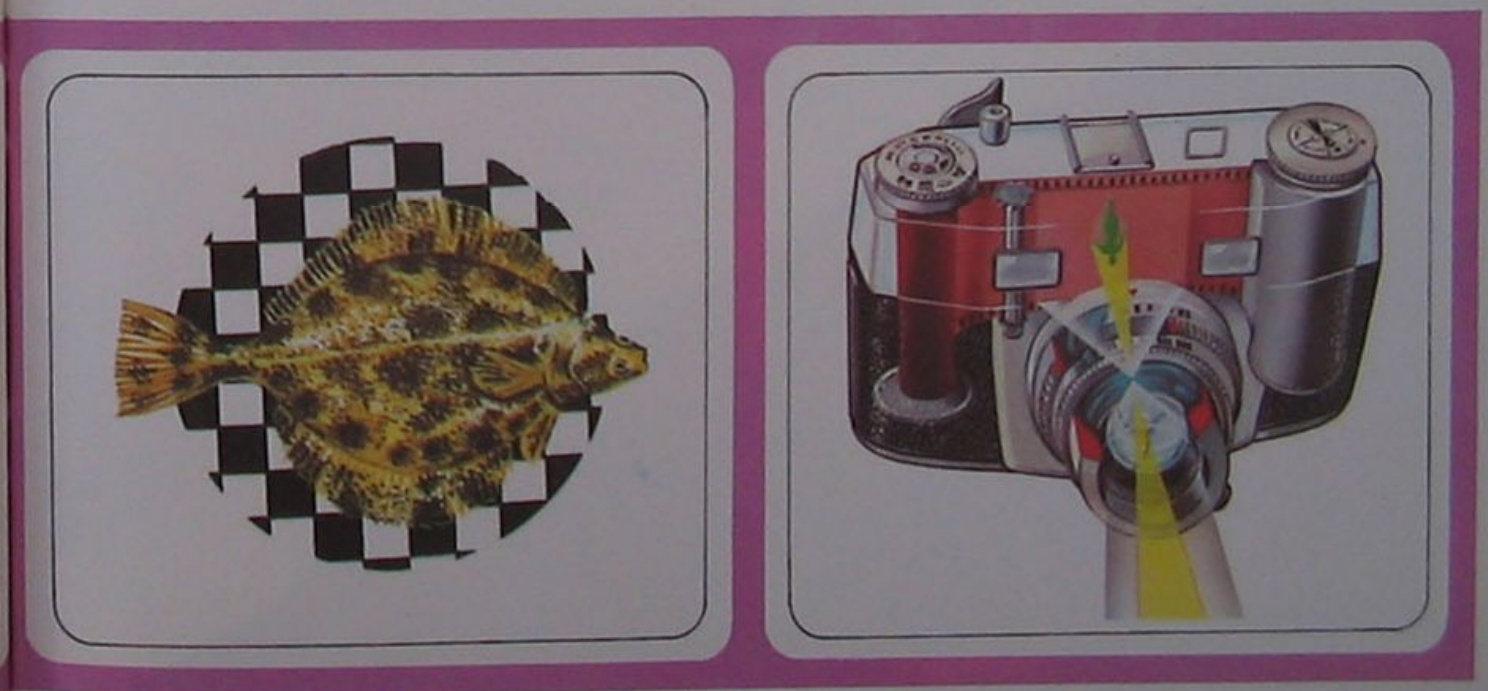


A bush fire rages through an Australian forest.

Bligh, William (1754-1817), was a British naval officer who is remembered chiefly for the mutiny that he faced on his ship H.M.S. *Bounty*. The *Bounty* set sail from Tahiti in 1789 with a cargo of breadfruit trees. Within a few days most of the crew found Bligh's harsh treatment unbearable, and mutinied. They cast Captain Bligh adrift in an open boat with 18 other men.

Bligh managed to navigate his way across more than 3,600 miles of ocean to Timor. Some of the mutineers settled on Pitcairn Island. Of ten others who were caught, three were later hanged. Bligh eventually became governor of New South Wales, and was later promoted to vice-admiral.

Blood is the body's transport system. It carries food and oxygen. It takes away waste materials, and distributes heat evenly. Blood also fights disease and infection.

A drop of blood contains millions of *corpuscles*—cell-like bodies suspended in a watery fluid called *plasma*. There are three main kinds of corpuscles: red corpuscles, white corpuscles, and platelets.

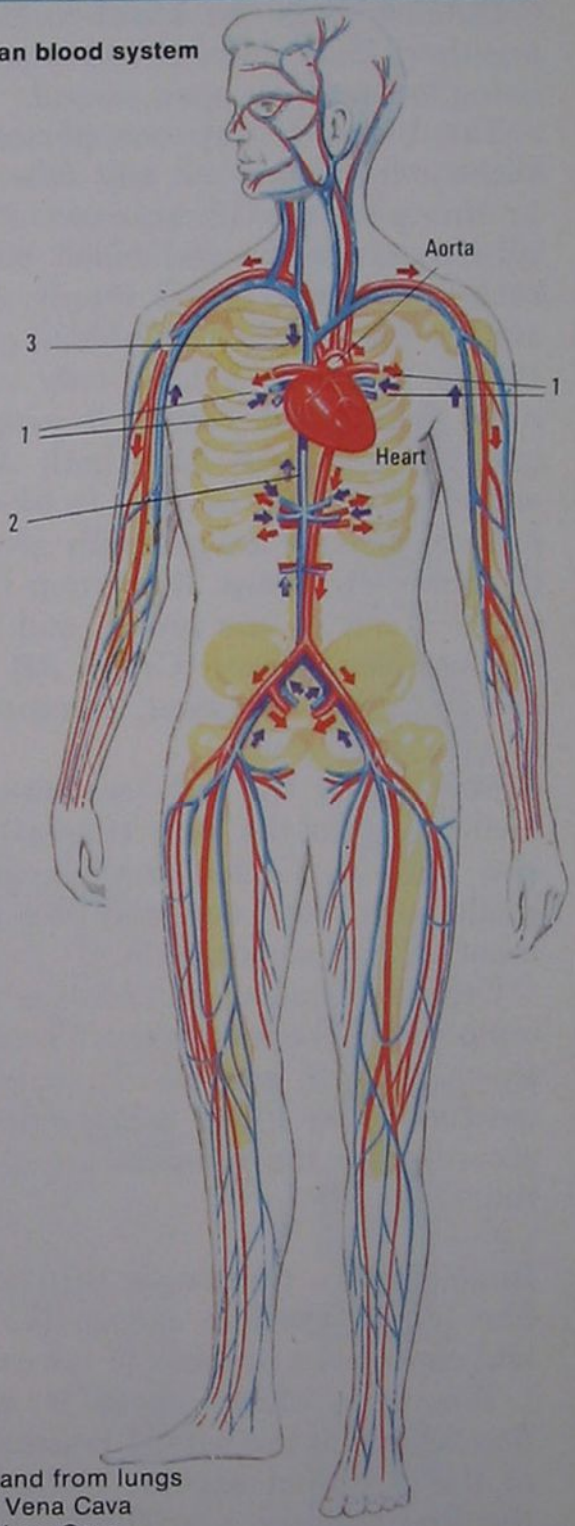
Normal red corpuscles

Naturally clotted red corpuscles which form scabs.

Adult human beings have about ten pints of blood in their bodies. People living at high altitudes, where there is less oxygen, may have four more pints of blood to help capture oxygen.

Red corpuscles are the blood's oxygen carriers. They contain a red substance called *haemoglobin*, which gives blood its colour. The disc-shaped red cells are so tiny that a drop of blood the size of

The human blood system



1. Blood to and from lungs
2. Posterior Vena Cava
3. Anterior Vena Cava

Arteries are shown in red, veins in blue.

a pin-head contains 4½ to 5 million of them.

White corpuscles are somewhat larger than red ones, and have irregular shapes. There are only about 5,000 to 10,000 of them in a drop of blood the size of a pin-head. Their job is to prevent infection and fight disease by surrounding and destroying any germs that enter the body.

Platelets help the blood to *clot* (stick together), and prevent too much blood being lost from an open wound.

The blood of any one person differs slightly from that of any other, owing to the presence or absence of certain substances in the red blood cells. Two such substances, called simply *A* and *B*, are the basis of the *ABO blood grouping*. People in group *A* have only substance *A* in their blood. Group *B* people have only *B*, group *AB* have both *A* and *B*, and group *O* have neither. In blood transfusions, patients are generally given blood of their own group. But group *O* can be safely given to any group, and is called the *universal donor*. Group *AB* is called the *universal recipient*, because it can receive any group.

Man is not the only creature to have blood. All but the very simplest animals also have it. Crabs, crayfish, and some snails have blood coloured blue by a pigment called *haemocyanin*.

Only in mammals and birds is the blood temperature kept constant. These are the *warm-blooded* animals. In *cold-blooded* creatures, the blood temperature varies according to the temperature of the surroundings.

Boadicea is a traditional British heroine. She led a rebellion against the Romans and captured a number of towns.

Boadicea, whose name is also spelt *Boudicca*, was the wife of Prasutagus, king of the Iceni, an ancient British tribe in the first century A.D. The Iceni lived in eastern England, in what are now the counties of Norfolk and Suffolk. When Prasutagus died in about A.D. 61 the Romans seized his kingdom and ill-treated Queen Boadicea, her daughters, and other members of their tribe. Boadicea led a revolt of the Iceni who destroyed the Roman city of Camulodunum (Colchester). She defeated a Roman army and set fire to the Roman cities of Verulamium (St Albans) and Londinium (London).

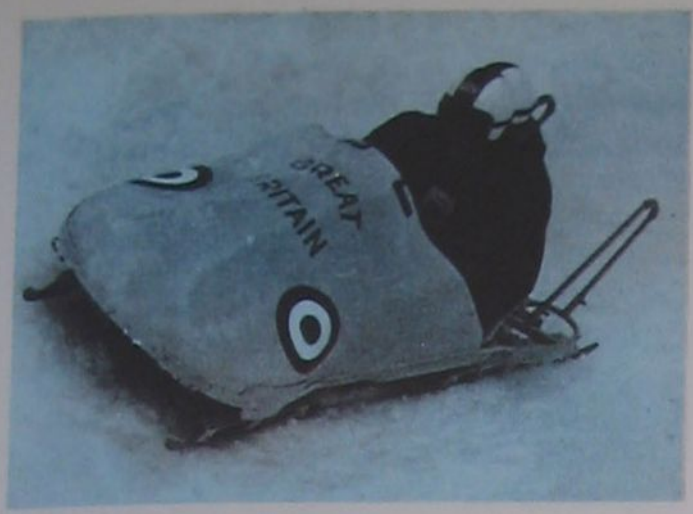
Boadicea's success did not last long. A Roman army, commanded by Suetonius Paulinus, met a British army somewhere in the Midlands. There were many more Britons than Romans but the Romans won an easy victory. Boadicea killed herself by taking poison to avoid being captured.

Bobsleigh This is the sport of sliding down ice slopes on hand-sleighs fitted with runners. It is often called *coasting* in the United States and Canada, and *tobogganing* in European countries.

The modern bobsleigh, developed from the wooden Swiss coaster, consists of two toboggans joined together steered by a wheel. 'Bobs' carry two or four riders seated upright, but 'skeletons' designed to accommodate one rider lying flat, head first, are also popular.

The first races were organized by the British in Davos, Switzerland, during the

This statue of Boadicea and her daughters can be seen near Westminster Bridge, London.



A practice run at the Riessersee, West Germany. The steep banking prevents the bobsleigh from flying over the edge at the curves.

late 19th century. Bobsleigh events were first included in the Winter Olympic Games of 1924. The Olympic four-man bob event has been won four times by Switzerland and three times by the U.S.A., and the World Championship—inaugurated in 1924—nine times by Switzerland. Italy have been two-man world champions thirteen times.

The most famous permanent artificial slope is the Cresta Run at St. Moritz, built in 1884, where annual Grand National Championships are held for skeleton one-man toboggans. The Cresta has steeply banked curves and its average gradient is 1 in 7.7.

Boer War This war was fought between Britain and the Boer States in South Africa (Transvaal and Orange Free State) from 1899-1902. Britain wished to see the 'Uitlanders' of the Transvaal granted equality. 'Uitlanders' were foreigners,

Below: A company of Canadian troops advances to capture a *Kopje* (hill) for Britain in the Boer War.
Inset: A London newsboy holds a poster proclaiming the relief of Mafeking.
Right: The chief commanders of the Boer War

Lord Roberts

Lord Kitchener

General Smuts

General de Wet

General Botha

chiefly from Britain, who had settled in Johannesburg when gold was discovered. The Boers (Dutch settlers) had always disliked British rule and feared they would lose their independence. They declared war on Britain in October 1899.

From October 1899 until January 1900 the Boers did well. Although untrained in war, they were expert shots, good horsemen and familiar with the countryside. British forces were besieged in Ladysmith, Mafeking and Kimberley. In December, during 'Black Week', the Boers won three battles.

By February 1900, reinforcements, commanded by Lord Roberts and General Kitchener, had been sent from Britain. Now with much larger armies, the British drove the Boers away from Ladysmith and Kimberley and defeated them at Paardeburg. Mafeking, where Colonel Baden-Powell had organized heroic resistance, was saved after a siege lasting 217 days. Pretoria, capital of Transvaal, was in British hands by September 1900.

The Boer soldiers fought on in small groups ('commandos'). They were well led by Generals De Wet, Botha and Smuts. They attacked camps, derailed trains and seized equipment. General Kitchener replied by burning farms and crops. The countryside was cleared of civilians who were placed in concentration camps, where 20,000 died because of unhealthy conditions.

By the Treaty of Vereeniging in May 1902 the Boer States lost their independence. In 1910, however, they became part of the self-governing Union of South Africa. Britain, who had earned hatred abroad for the methods used to win the war, paid £3 million towards the rebuilding of Boer farms.

Bohr, Niels (1885-1962), a Dane, was one of the outstanding physicists of the 20th century. He was awarded a Nobel Prize in physics in 1922 for his explanation of the structure of the atom, based on Max Planck's *Quantum theory*. Bohr stated that the electrons which orbit the atom's nucleus do so in distinct 'shells' corresponding to different energy levels. In jumping from one level to another, they take on or give off units (or *quanta*) of energy (light waves).

Bohr was born in Copenhagen. He went to England in 1911 and worked at Cambridge with Ernest Rutherford, who constructed the first model of the atom. In 1920, he became head of the influential Institute for Theoretical Physics at Copenhagen University.

Bohr left Denmark in 1943 during World War II, and went to the United States where he advised on the atomic bomb. He later argued for the control of such weapons.

Boilers and heating A boiler is a device that produces steam from water, under pressure. The steam is used for heating houses, offices, and factories, or for operating steam engines and steam turbines. The name boiler is also given to a domestic water heater.

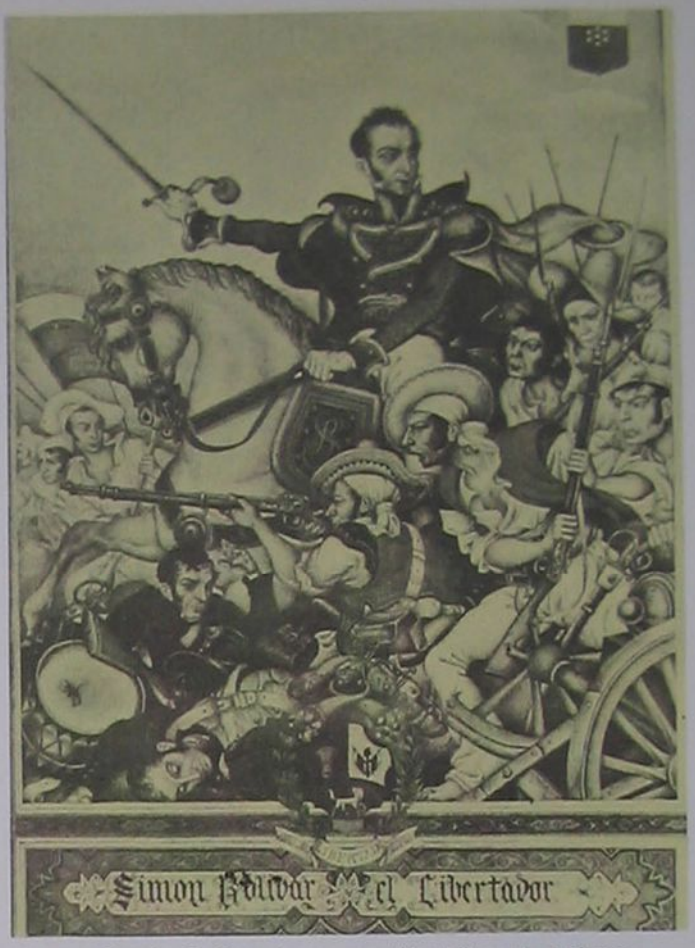
A boiler has two parts—a specially built steel container strong enough to withstand the pressure of the steam, and a furnace or fire-box to heat the water. The furnace can be either underneath or inside the container. Many fuels including coal, coke, oil, gas and wood are used.

In some boilers the water circulates in pipes through the fire or hot gases; in others, hot gases circulate in pipes through a tank of water. In the former design steam can be superheated. All boilers have a safety valve to prevent pressure from building up to a dangerous level and causing an explosion.

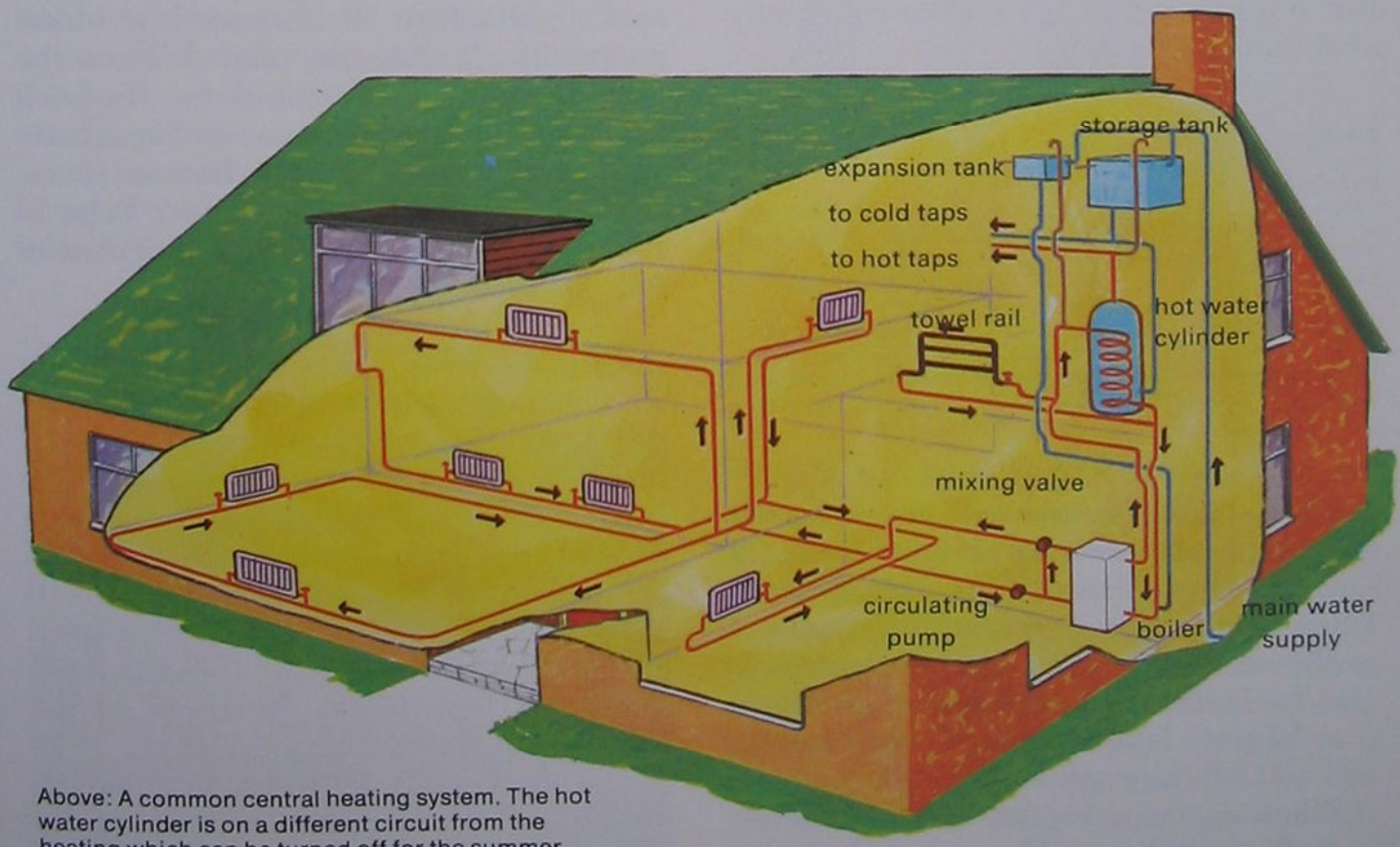
In a house or other buildings that are centrally heated, the boiler is often located in the basement. The steam or hot water is sent up through pipes to radiators in each room. In some systems, hot water comes up to metal convectors in the rooms, or to pipes under the floor. Electric central heating and systems which heat the air directly do not require a boiler.

Bolívar, Simón (1783-1830) was one of South America's greatest heroes. He organized armies that gained many victories over the Spaniards. He became known as the 'Liberator' because he won independence for Bolivia, Colombia, Ecuador, Peru and Venezuela. All these countries were Spanish colonies but became independent republics because of Bolívar's efforts. But Bolívar refused to share the power he won, and made many enemies.

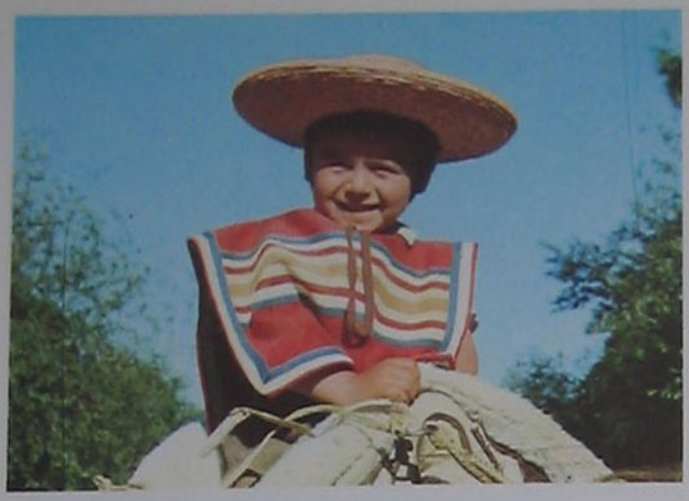
Bolívar was born in Caracas, Venezuela. He was sent to Europe as a young man and studied in Madrid. Bolívar vowed to free Venezuela from Spanish rule. He joined a group of people who seized control of Caracas in 1810 and formed the first government in South America chosen by local people. After a series of struggles against the Spaniards, he became first president of the republic of Colombia (now the separate republics of Panama, Venezuela, Ecuador and Colombia). In the next few years he led the struggle that ended Spanish rule in South America. But gradually the people of the countries that



Above: Simón Bolívar, known as 'the Liberator' since he won many countries their independence, is shown riding over the hated Spanish rulers of South America.



Above: A common central heating system. The hot water cylinder is on a different circuit from the heating which can be turned off for the summer.



Facts and Figures
Area: 424,163 square miles
Population: 4,931,000.
Capital: La Paz (actual); Sucre (official).

Bolivia is one of the least heavily populated of all the South American Republics. Its loss of its coastline to Chile has been a factor in its slow economic development. Above: National costume.

made up the new republic set up their own republics. By 1829 Bolivar ruled only what is now Colombia.

Talking points
* Simón Bolívar is known as *El Libertador* (The Liberator). Compare his career with those of other national heroes and 'Liberators', George Washington, for example.
* Give reasons why the South American colonies broke away from Spain. How do these compare with those of modern colonies recently gaining independence?
* Why did Bolívar's great plan for uniting the northern part of South America fail? How is he regarded today?

Articles to read
Bolivia; Colombia; Equador; O'Higgins; Peru; San Martin; South America; Spain; Venezuela.

Bolivia is a South American country with no coastline. Snow covers the peaks of Bolivia's Andes mountains in the west. Thick tropical forests grow in the valleys to the east and north of the mountains. The lowlands of the north and east form the largest land region. Temperatures and rainfall vary greatly.

Tin is a major export. Other minerals include copper, gold and petroleum. Farmers grow millet, potatoes and wheat. On the lowlands, they raise cattle.

About half the people of Bolivia are Amerinds, who speak their own language. Spanish-speaking people of European descent live in the cities. The rest of the people are a mixed group called *mestizos*. Most Bolivians are Roman Catholics.

Spanish conquerors took Bolivia (then Upper Peru) in the early 1500's. They ruled for 300 years until Simón Bolívar, a Venezuelan revolutionary, finally drove them out. Upper Peru became an independent republic called Bolivia (after Bolívar) in 1825. In 1879-1883 and in 1932-35, Bolivia lost disastrous wars, first against Chile, then against Paraguay.

Lake Titicaca lies on the border between Bolivia and Peru. This lake is the world's highest large lake. It is about 12,000 feet above sea level.

Bologna (pop. 482,438) is a city in northern Italy at the foot of the Apennine Mountains, about 65 miles north of Florence. It is the capital of the region of Emilia Romagna. Bologna is a treasury of medieval architecture. It also has the oldest university in Europe, dating from the 11th century. It is noted for its foodstuffs, particularly sausages and spaghetti.

Bologna started in pre-Roman times, and came under the rule of the Pope in 1506. It became part of the Kingdom of Italy in 1860.

Bolsheviks were the Communist group who gained control of Russia following the revolution of November 1917. The name in Russian means 'majority'. The Bolsheviks were led by Vladimir Lenin, a tireless revolutionary, who believed in the socialist principles expressed by Karl Marx and Friedrich Engels in the *Communist Manifesto* of 1848. The Manifesto called for the violent overthrow of the existing capitalist society.

The Bolsheviks believed in a disciplined, and highly organized group of professional revolutionaries to lead the

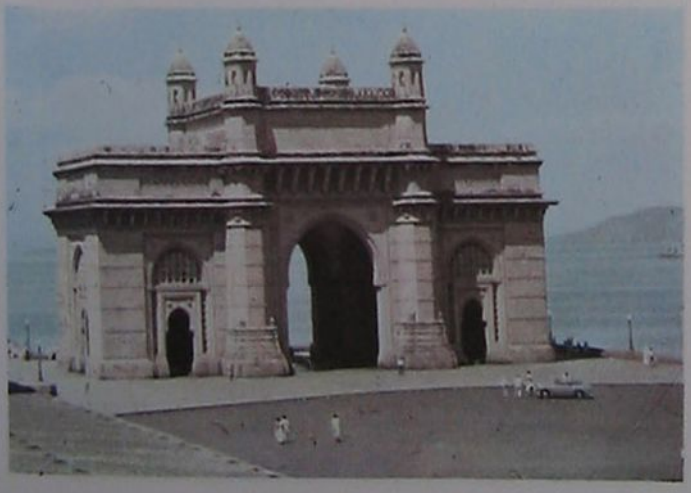
workers. They were opposed by a more moderate group, the Mensheviks (or 'minority'), who wanted a more open party membership.

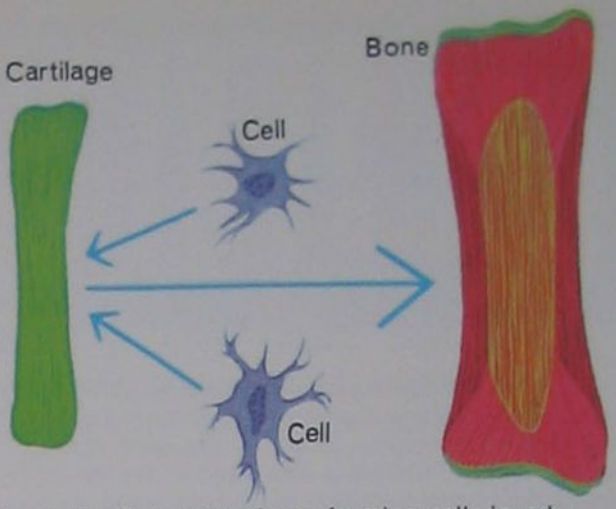
The tsar of Russia, Nicholas II, had granted some political reforms after a short-lived revolution in 1905. But he was overthrown by a revolution of workers and soldiers in March 1917, during World War I. The Bolsheviks were only one group who participated in this event. Their power grew, however, and in November they seized control in a second revolution. From then on they controlled both the Communist party and the country.

Bombay (pop. 5,931,981) is the capital of Maharashtra state, in western India. Its magnificent harbour opens on to the Arabian Sea, and is one of the busiest in India. Because of its trade, industries and wide range of manufactures, it is a major commercial centre. It is also the centre of India's film industry, one of the largest in the world.

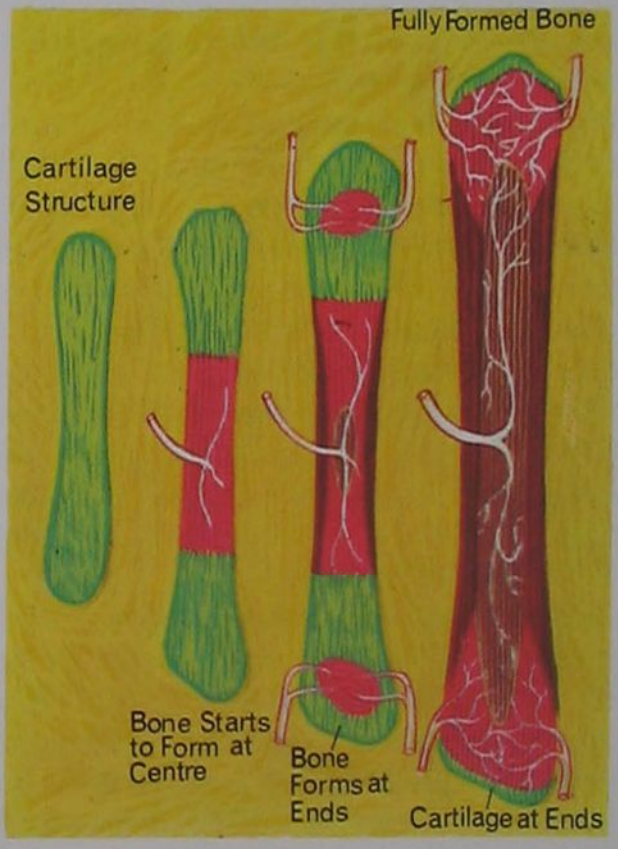
Most of the people of Bombay are Hindus. But Parsees, who follow the Zoroastrian faith, play an important part in Bombay's commercial life. The city has many colleges and technical institutes, museums, and a university. Bombay was founded in the late 17th century when the British East India Company settled there.

The Gateway to India symbolises Bombay.





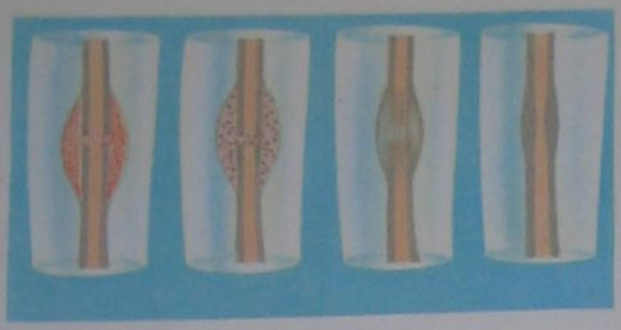
Bones may form when bone-forming cells invade structures already laid down in the embryo as cartilage. The result is *cartilage* or *endochondral* bones. Most bones in Man's skeleton form in this way.



Limb bones are first formed of cartilage and gradually converted into bone (ossified).

Bone is the hard, rigid substance forming the *skeleton* (framework) that supports the bodies of human beings and other *vertebrates* (animals with backbones).

Whatever their shape, bones generally consist of two main parts: an outer layer of hard *compact* tissue and an inner, *spongy* part. On the very outside is a covering called the *periosteum*. In the spongy parts of many bones is a reddish fatty substance called *marrow*. This is



Four stages in the healing of a fractured (broken) bone. 1. The blood round the fracture clots to form a gluey mass called a haematoma. 2. and 3. The haematoma forms into tissue. Calcium is deposited in the tissue, making a rigid bond (a callus) across the break. 4. Bone cells take the place of the calcium.

where the red blood corpuscles are made, and a network of tiny blood vessels pass through the marrow.

Bone consists largely of mineral matter: mainly calcium and phosphorus, with some magnesium. A young person, whose bones are growing, needs a lot of these minerals. The best source is milk.

When a bone is *fractured* (broken), it can repair itself if the broken ends are properly brought together and held that way for several weeks. This gives the broken ends time to *knit*, or grow together.

Bonn (city and suburbs pop. 299,376) is the capital of the German Federal Republic. It is the birthplace of the composer Beethoven and has a famous university. The Münster cathedral in the centre of the city dates from the 12th century.

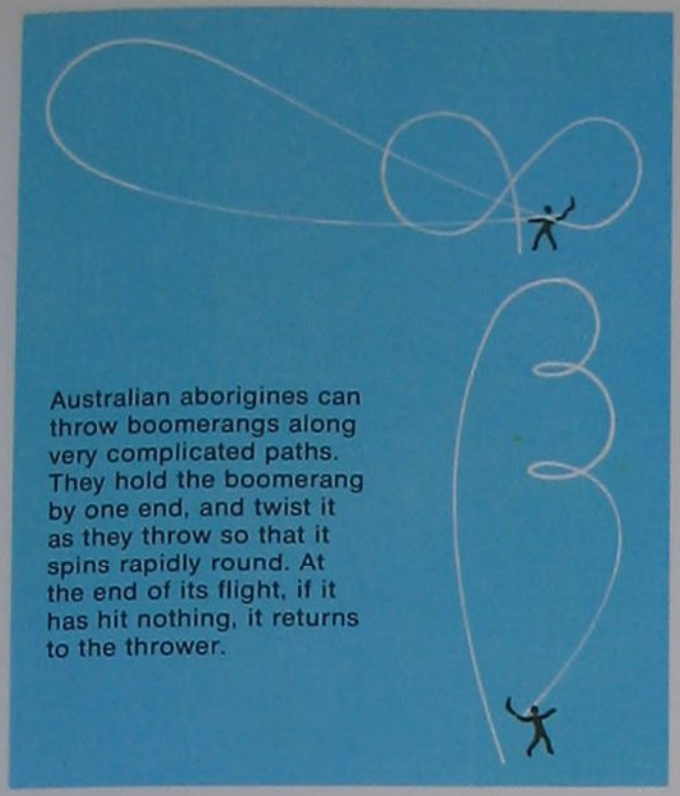
Much of the city was destroyed in the Second World War, but today it is a busy metropolitan centre. It is also known as a centre for the arts.

Bonnie Prince Charlie (1720-1788) was a Scottish national hero. The name was given to Charles Edward Stuart by his Scottish supporters. Charles was the grandson of James II of Britain. Charles was called the *Young Pretender* because he claimed the British crown, but he did not succeed in becoming king.

Charles was born in Rome. The Jacobites (supporters of the Stuart family who wanted them to be on the British throne) soon began to hope that Charles would become king. They promised the support of 20,000 men if he came to Britain. By 1740 the French king was also promising to help, so Charles set out for Scotland. He arrived on an island in the Hebrides on 2nd August, 1745. His supporters gathered round him and on August 19 he began his march towards England at the head of an army.

The Jacobites defeated the English at Prestonpans, and Charles marched towards London with a large army. He evaded English forces sent to meet them and reached Derby. But on December 6, Charles began to retreat. The English, under the Duke of Cumberland, met his forces on Culloden Moor on 16th April, 1746, and inflicted a heavy defeat. Charles hid for several months and fled to France. He lived the rest of his life mostly in France and Italy.

Prince Charles Edward as a young man. Popularly known as Bonnie Prince Charlie, he was only 26 years old when he was finally defeated by the English at Culloden—the same age as his opponent, the Duke of Cumberland.



Australian aborigines can throw boomerangs along very complicated paths. They hold the boomerang by one end, and twist it as they throw so that it spins rapidly round. At the end of its flight, if it has hit nothing, it returns to the thrower.

Boomerang is a throwing-stick used as a hunting weapon by the Australian Aborigines. It consists of a hard wooden blade, about 30 inches long, and curved through a quarter of a circle. The blade is flat on one side and curved on the other. The thrower aims the boomerang at a target. If it misses, it flies through the air in a curve and returns to the thrower. The Aborigines can hurl the boomerang over long distances with great accuracy.

Curved clubs have been found in many parts of the world, and some prehistoric peoples used boomerangs in warfare.

Bordeaux (pop. 266,662) is a city and major seaport in south-western France. It is the capital of the Gironde department, and stands on the River Garonne, some 60 miles inland from the Atlantic. The region is famous for its vineyards, and Bordeaux is an export centre for the wine trade. The city was founded on a Roman site. It came under English rule from 1152 to 1453. In World War II it was heavily damaged.

Borneo is a large island in south-east Asia. It lies on the equator in the Malay Archipelago, south-west of the Philippines. It is the third largest island in the world (288,242 square miles in area), but with only six million people, is rather sparsely inhabited.

About 70% of Borneo belongs to Indonesia. This part is called Kalimantan. The rest consists of Sarawak and Sabah, both members of the Federation of Malaysia since 1963, and Brunei, a sultanate under British protection. These three states are in the north and north-east.

Borneo's interior is rugged and very mountainous. The chief ranges are the Kapuas and the Schwaner; the highest point is Mt Kinabalu (13,455 ft). Jungles and dense rain forests cover much of the island, making communications difficult. The interior is reached mostly by small boats and villages are built beside rivers. The coastal areas are low and swampy. Water buffalo are a common means of transport here.

The climate of the island is hot and damp all year round, but the monsoons bring the most rain between November and May. Animal life is rich and varied, including apes, leopards, deer, some surviving rhinos, and wild oxen.

Native Dyaks, living in the interior and coastal areas, form the largest group of inhabitants. They grow rice in jungle clearings, and also hunt and fish. Whole villages live together in long houses built on piles. The Dyaks have a primitive religion and once practised head-hunting. The rest of Borneo's population consists of Malays, who practise the Muslim religion, and Chinese.

Farmers in Borneo grow rice and sago for their own use, and export rubber, spices, coconut and tobacco. Although the forests are rich in teak, sandalwood, camphor and other valuable trees, the timber is difficult to get out. Oil is the principal mineral exported. Coal, iron, copper and diamonds are also mined.

The Portuguese first came to Borneo in the 1500's and established trade there, along with the Spanish. Dutch and British

traders came in the 1600's. During the 1800's, the Dutch gained control of south Borneo and Britain gained the three protectorates of Sarawak, North Borneo (now Sabah), and Brunei. Dutch Borneo became part of the Republic of Indonesia in 1950.

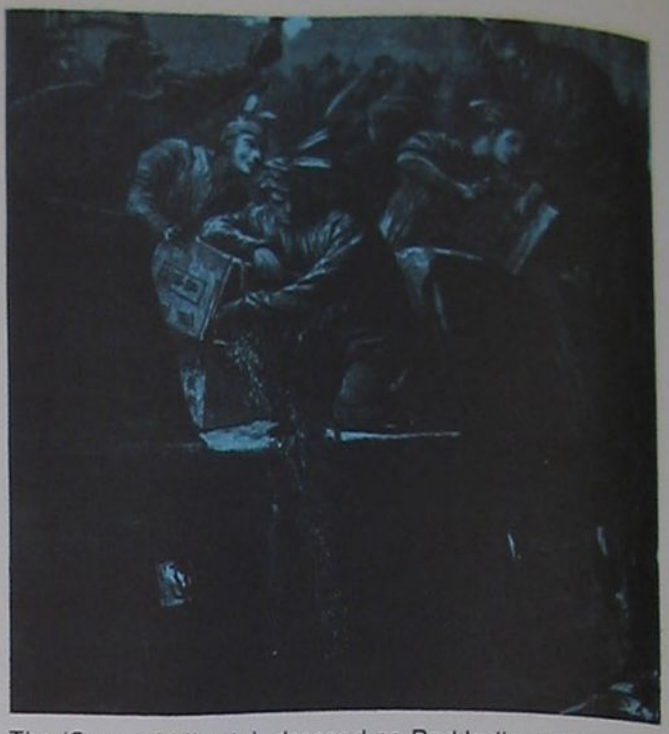
Bosporus is the name of a narrow strait in Turkey which is part of one of the world's greatest waterways. It links the Black Sea to the Sea of Marmara, the Dardanelles Strait and the Mediterranean Sea. This waterway is part of the border between Europe and Asia. The Bosporus is 19 miles long and between a half and two miles wide.

The Bosporus is of great importance to Russia because it is part of the only ship outlet which Russia can use all the year round. All Russia's northern ports are closed by ice in winter.

Villas and castles line the banks of the Bosporus. The ancient city of Istanbul, formerly called Constantinople, and earlier still Byzantium, lies near the southern end of the Bosporus.

The name Bosporus comes from two Greek words meaning 'ox ford'. It probably got its name from a Greek legend, which told how Io, a princess loved by the god Zeus, was changed into a white heifer by Hera, a jealous goddess. In the story, the heifer swims the Bosporus.

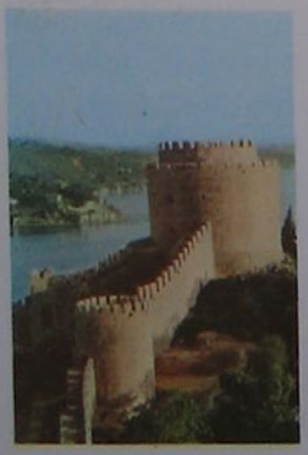
Boston is the capital of Massachusetts, in the United States. It is an important seaport, and with its suburbs has a population of over 2½ million. It is also a major industrial and trading centre, and a centre of learning, with Harvard University and Massachusetts Institute of Technology.

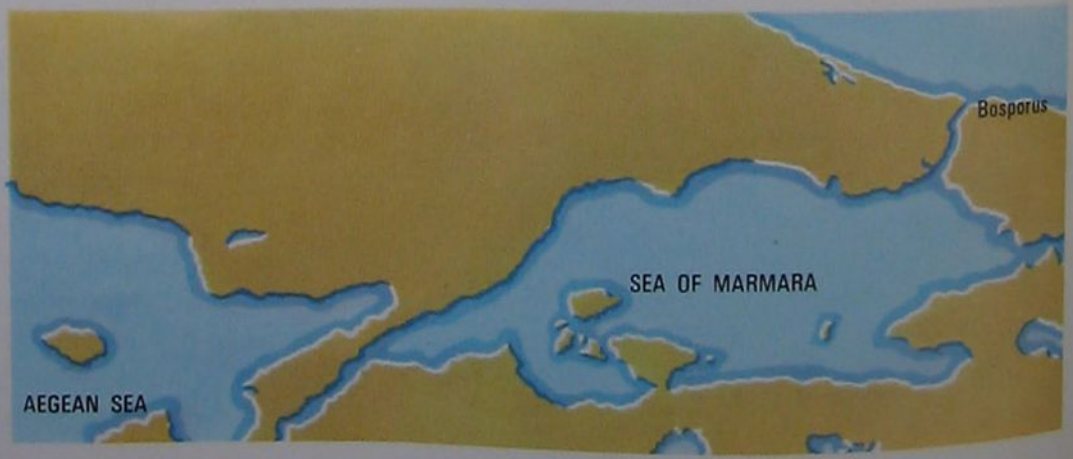


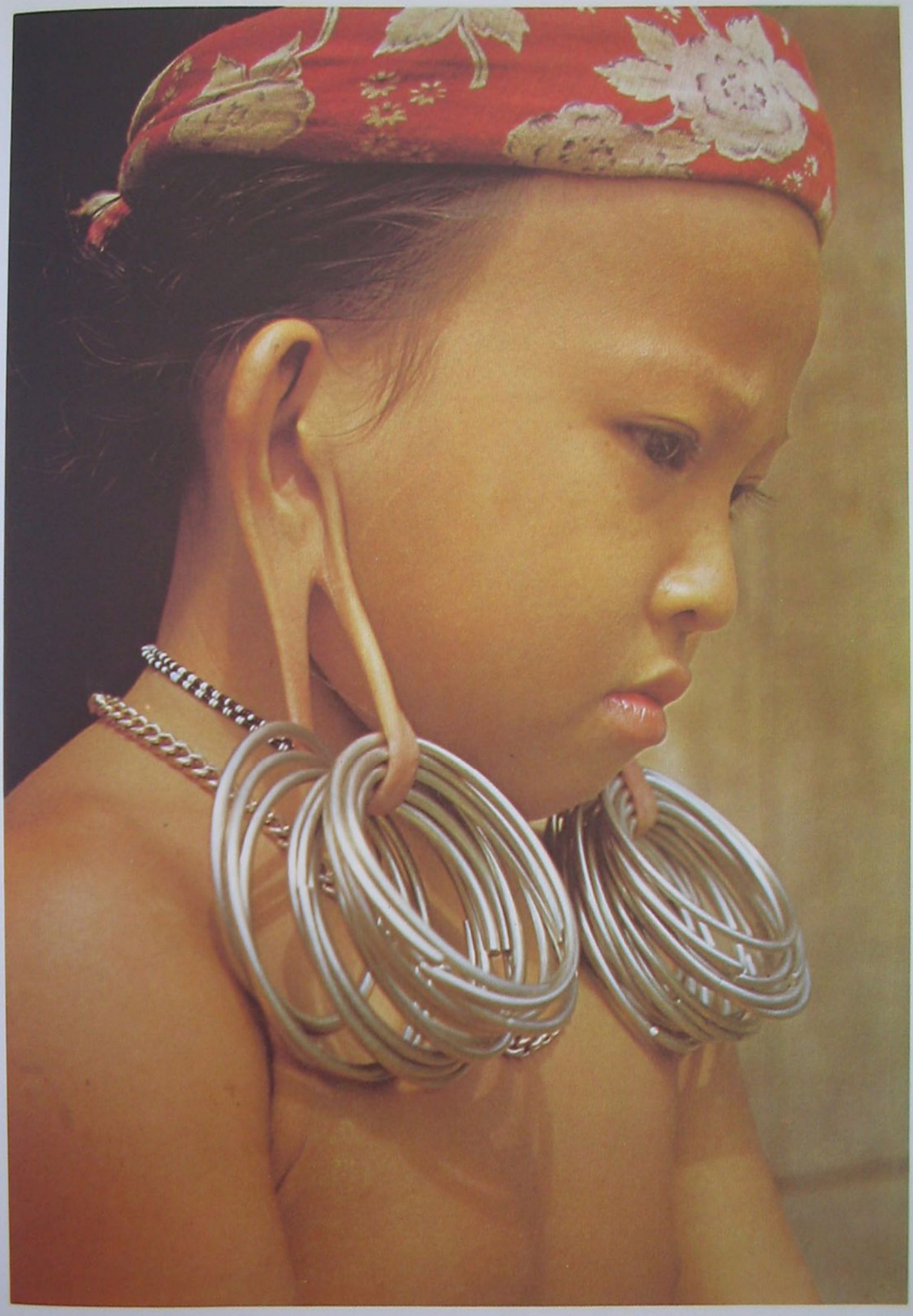
The 'Sons of Liberty', dressed as Red Indians, tip £10,000 worth of tea into Boston harbour rather than pay duty on it.

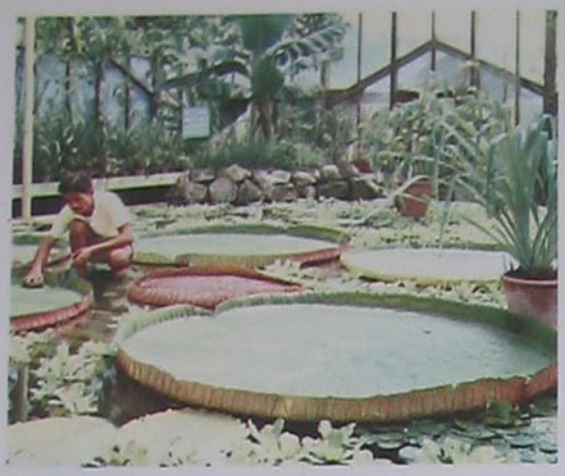
In the 17th century the New England area became the home of people from Britain, who were mostly Puritans. Boston grew to be the centre of American puritanism. The city became world-famous after the Boston Tea Party of 1773, when a cargo of tea was dumped in the harbour as a protest against Britain's heavy taxation.

Below: Lying at the north-east corner of the Sea of Marmara, the Bosporus divides Europe from Asia. The fortifications that line its banks are a reminder of its strategic role in history. Opposite: A native girl from Borneo.









The Royal Botanic Gardens at Kew, London. Far Left: A student cleans the leaves of *Victoria regia*, a giant water lily, which is grown from a seed the size of a pea. Left: The curiously shaped Crane Flower *(Strelitzia reginae)* so called because of its resemblance to the bird of that name.

Botanical gardens are areas of land laid out to display or preserve rare or interesting kinds of plants. Botanical gardens originated with the study of plant growth and structure at universities in the 1500's. Thus, the University of Padua, in Italy, was the first to have its own garden designed specifically to provide study material for its botany students. Few botanical gardens of this kind remain today, however. Modern gardens serve more as a living inventory of exotic plants than as places of study. Kew Gardens, near London, one of the world's great centres of plant study, is both a garden and a *herbarium* (a museum where plant specimens are dried and preserved).

Closely associated with the origins of botanical gardens are *physic gardens*. These became specialized gardens for

Captain Cook lands at Botany Bay with a party from H.M.S. *Endeavour*. The inlet's name was suggested to Cook by the expedition's naturalist, Joseph Banks, who found many new plants in the area.

growing herbs that contain medicines. The famous Chelsea Physic Garden was founded by the Worshipful Company of Apothecaries in 1673. It is still used as an establishment for botanical research.

Botany is the science and study of plant life. It includes the study of where plants live, how they function, what they look like, and their usefulness to man and animals.

Botany Bay is an inlet on the south-eastern coast of Australia, about 7 miles south of Sydney. It was the site of the first European landing on the eastern coast of the continent. On April 28, 1770, James Cook sailed into Botany Bay on board H.M.S. *Endeavour*. The naturalist Sir Joseph Banks, who accompanied Cook, gathered many unusual plants in the area, and this gave Cook the idea for the name of the inlet.

The British government decided, on Banks's recommendation, to establish a settlement on the site for convicts deported from Britain. Arthur Phillip was appointed governor of the new settlement. He arrived at Botany Bay in January 1788. After spending barely a week in the region he became dissatisfied with it and moved to the site on which Sydney now stands.

Botswana is a large landlocked country in southern Africa. It covers an area of 222,000 square miles, much of which is desert. Most of Botswana's 648,000 people live in the east, where the capital, Gaberones, is located. The chief products include cattle, hides, and skins and meat. Botswana was a British protectorate called Bechuanaland until 1966, when it became an independent republic.

This map shows the location of Botswana.

Bowerbirds are a family of Australian perching birds related to birds of paradise. They get their name from the cock bird's habit of building *bowers* or tunnels in the bushes and shrubs, during courtship. The bowers are decorated with small pebbles, bright feathers, shells, bones and similar objects. The satin bowerbird is one of the best known *species* (kinds). Bowerbirds are also found in New Guinea.

The Australian bowerbirds build elaborately decorated bowers during courtship. They are related to the birds of paradise.

Bowling, sometimes called ten-pins, is a popular indoor game that grew up in the United States.

In its most common form, the bowler rolls a large composition ball, weighing between 10 and 16 pounds, down a 60-foot wooden alley toward 10 pins symmetrically arranged at the other end. In each 'frame' he has two chances to knock down all 10 pins. If he knocks them all down with the first ball, he is credited with a 'strike', and scores 10 pins plus the total of his next two balls. If he knocks down all 10 with two balls, he earns a 'spare' and scores 10 plus the number he gets on the next single ball. If he does not make a strike or spare, his score is just the number of pins he has knocked down. A game lasts 10 frames. If a player scores 12 strikes in a row, he has bowled a 'perfect game' of 300.

Variations of bowling, some of which are still played today, have been traced back by archaeologists to as long as 5,000 years ago.

Boxing Fist-fighting was practised in ancient times, but owes its origin in modern form to the Queensberry Rules, drawn up by the 8th Marquis of Queensberry in 1867. In fact, the legality of boxing in Britain was not established until a court ruling on April 24, 1901.

The Queensberry Rules, which made the use of gloves compulsory, put emphasis on skill, and defined the number and duration of rounds to be fought, remain the basis of modern boxing. Previously, prize-fighting with bare fists took place in private, rounds ending only when a contestant fell. One fight in Cheshire in 1825 lasted 278 such rounds. Jack Broughton first introduced gloves for practice purposes in 1743.

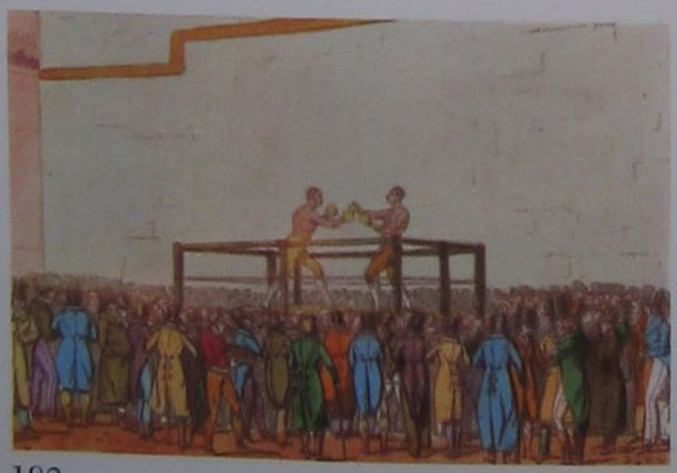
Professional boxers today are divided into weight categories, from 8-stone flyweights to heavyweights (any weight). Rules clearly instruct referees how to conduct contests and decide the winner, and have been suitably modified to suit junior and senior amateurs.

Points are awarded at the end of each round for skill in both attack and defence and, where contestants are otherwise equal, for style. To score, hits must be made cleanly and directly with the knuckle part of the glove of either hand to any part of the front or sides of an opponent's head, or his body above the belt. The belt is an imaginary line drawn across the body from the top of the hip bones.

Amateur contests usually consist of 3 rounds of 3 minutes each with 1 minute rests between rounds. Professional bouts may now consist of any number of 3-minute rounds up to a maximum of 15.

The first world heavyweight championship fight with gloves and 3-minute rounds was fought between John L. Sullivan and James J. Corbett in New Orleans, Louisiana, U.S.A., on September 7, 1892. Corbett won in 21 rounds. Joe Louis held the world heavyweight title from June 22, 1937 to March 1, 1949, during which time he made a record 25 defences of that title. The only man to win three Olympic Boxing Gold medals is Laszlo Papp of Hungary who was middleweight champion in 1948 and light-middleweight in 1952 and 1956.

Right: John, Eighth Marquis of Queensberry (1844-1900), drew up a set of rules on which modern boxing rules are largely based. Below: A boxing match of the late 1700's. Far right: Johnny Conteh, the young British boxer.



A blind man reads the script of a radio programme in Braille, and 'looks' at the time on his watch, by touch.

Braille is a method of writing that blind people can understand. Each letter of the alphabet is represented by a pattern of raised dots on a page. A blind person can touch and understand these. He reads by running his fingers rapidly over the raised characters. Each braille character contains up to six dots in a pattern. The pattern is up to three dots high and two dots wide. There are 63 combinations of dots altogether. In addition to letters of the alphabet, the characters stand for simple words and combinations of letters as well as numbers and punctuation marks. Thus, one dot means *a*, and six dots mean *for*. Braille can be read at a speed of 200 words a minute, which is about half the reading speed of a rapid-reading person with sight.

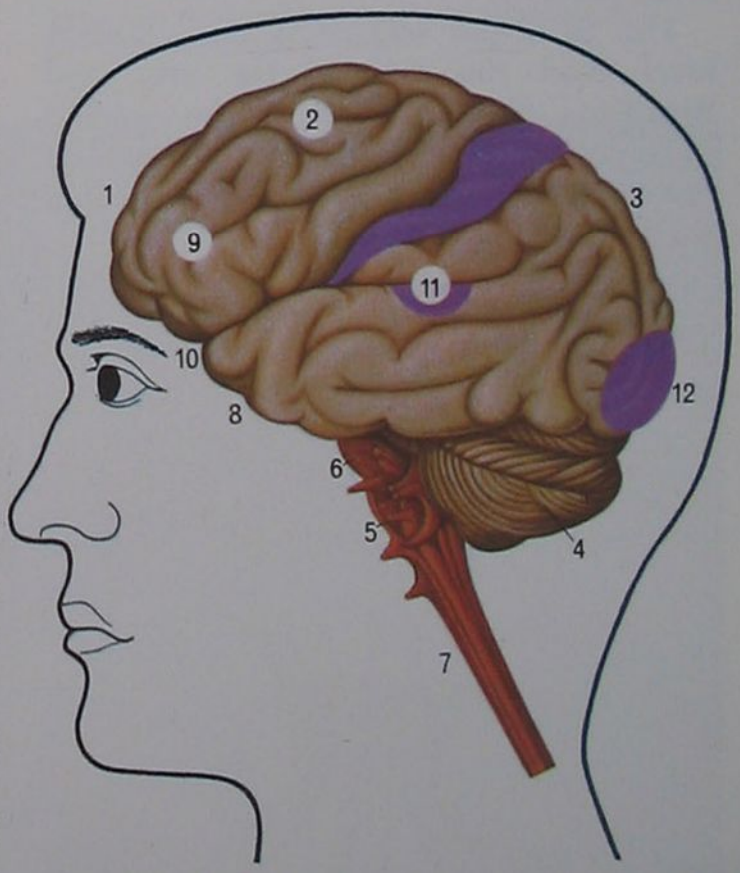
Braille was invented by a blind Frenchman, Louis Braille, in 1829, and his system is now used for all written languages. A blind person can write braille by using a braillewriter, a machine like a simple typewriter.

Brain The brain is the control centre of the body. It receives messages along nerves from sense organs in all parts of the body, and sends signals to muscles and glands to take any necessary action. The brain controls all our life processes and is where thinking takes place.

The brain, with the spinal cord, forms the *central nervous system*. The brain has several distinct parts. Although each part is interconnected, each of the parts has a special function.

The *brain stem*, which is the extension of the spinal cord, is the central core of the brain, from which various *lobes* extend. The biggest are the twin *cerebral hemispheres*, which form the topmost part of the brain. The surface of the hemispheres is folded in and out and consists of nerve cells which form the *grey matter*. Beneath this is the *white matter*, which consists of bundles of nerve fibres connecting the various parts of the brain with each other and with the nerves of the body.

The cerebral hemispheres form the *cerebrum*. The cerebrum is the part of the brain most developed in man. It gives him his powers of speech and reasoning. The rearmost part of the brain stem, the *medulla oblongata*, controls the basic



The human brain, showing some of the important areas and the activities they control: 1. Frontal Lobe, 2. Cerebrum, 3. Occipital Lobe, 4. Cerebellum, 5. Medulla Oblongata, 6. Pons, 7. Spinal Cord, 8. Temporal Lobe, 9. Speech, 10. Smell, 11. Hearing, 12. Sight.

actions such as heart-beat and breathing which continue to be governed when we are unconscious. Above the medulla oblongata is a lobe called the *cerebellum*. This acts like the automatic pilot in an aircraft. Once we have learned to carry out complicated movements that require balance and co-ordination, such as walking or riding a bicycle, the cerebellum enables us to carry them out automatically.

Brasília is the capital of Brazil. Built in the late 1950's, it is one of the most well-planned cities in the world. Brasília replaced Rio de Janeiro as the capital in 1960.

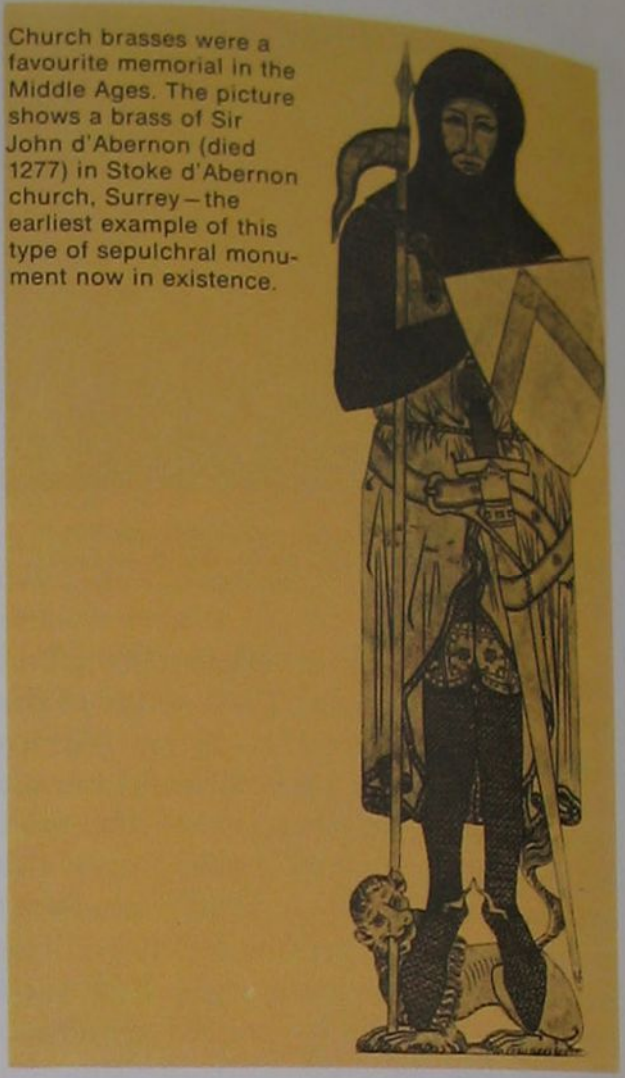
The plans for Brasília were decided upon after a competition between architects. The competition was won by Lúcio Costa. His designs had many unusual features. From the air, the main part of the city looks to many people like the shape of an enormous aircraft. The city lies on a plateau in the central part of the country.

The principal square is on a higher level than the rest of the city, and Brazilians claim that it is the world's largest city square. Round the square are many important buildings, including government offices.

Three rivers were altered so that they flowed into nearby Lake Pinheiro. On this lake stands the President's Palace. The overflow from the lake is used to irrigate land for farming.

The Cathedral of the Future, Brasília.

Church brasses were a favourite memorial in the Middle Ages. The picture shows a brass of Sir John d'Abernon (died 1277) in Stoke d'Abernon church, Surrey—the earliest example of this type of sepulchral monument now in existence.



Brass is one of our best-known alloys, made from copper and zinc. It is used for making all kinds of objects, from door-handles and screws to electrical fittings and cartridge cases. It has an attractive golden yellow colour, but tarnishes easily and therefore needs constant cleaning.

There are many different kinds of brass, each with different amounts of copper and zinc. The brasses get harder and stronger as the content of zinc rises. Aluminium and iron are sometimes added to brass to make it stronger. Adding lead to brass makes it easier to machine.

Brass instruments are musical wind instruments that were originally made of brass but which today may be made of other metals. They consist of a cup-shaped or funnel-shaped mouthpiece attached to a long tube that ends in a

wide, bell-shaped opening. Horns, trumpets, trombones and tubas are the usual orchestral brass instruments.

The player purses his lips inside the mouthpiece and blows through them. His breath causes the column of air in the tube to vibrate. He varies the notes by varying the pressure of his lips. But he cannot sound every note in this way. To achieve the full scale he has to alter the length of the tube. He does this by pressing keys that operate valves. These open up extra sections of tubing, allowing lower notes to be played. Trombones have an extra bent section of tubing that slides in and out of the main tube to alter its overall length.

The *French horn*, one of the most difficult instruments to play, developed from the primitive hunting horn. It has a mellow, muffled tone, which the player can vary by putting his hand inside the bell. The *trumpet*, whose eight-foot tube is coiled back on itself, has a bright, military sound, and is one of the most popular brass instruments. The *cornet* is a smaller version and the *flugel horn* a larger version of the trumpet.

The old English name for the *trombone* was the *sackbut*. The trombone player can slide from one note to another, as on a stringed instrument. The *tuba* is the largest and deepest sounding of the brass. It has a rumbling, blurting kind of sound. Smaller tubas are called *euphoniums*.

Brazil is the largest country in South America and the fifth largest in the world. The mighty Amazon River flows through northern Brazil across a broad plain. This plain has been built up by silt and sand dropped by the river when it floods (see Amazon). Most of the rest of Brazil is made up of plateaux, with some high mountains in the south-east.

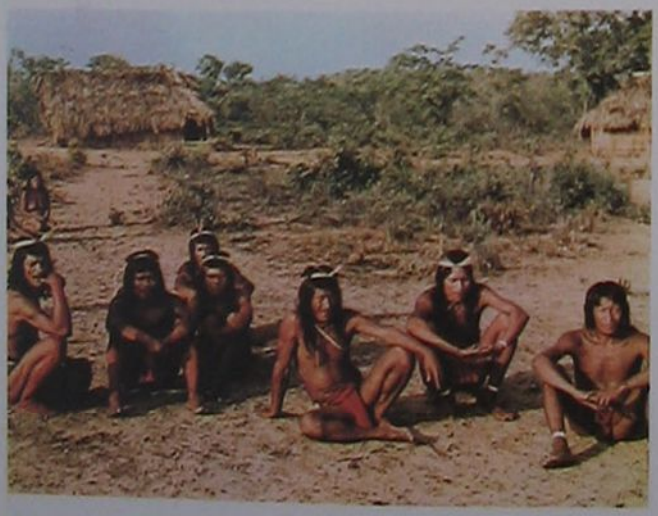
The rainfall is heavy in the Amazon region, especially in summer. This hot,

Young members of a Salvation Army brass band at rehearsal. The instruments used in brass bands are similar to the orchestral brass instruments. Most bands use combinations of cornets, flugel horns, trombones, and euphoniums.

The map shows the size of Brazil. It is easily the largest country in South America. The clock in front of the modern office block is a reminder of the old Portuguese colonial days.

Brazil. Loading a cargo of jute on to a river boat.

Facts and Figures
Area: 3,286,478 square miles.
Population: 93,000,000.
Capital: Brasília.
Money Unit: cruzeiro.
Labour force: 45% urban; 55% rural.



Many Indians in Brazil lead a very primitive life and have a hard struggle for survival.

wet region has vast forests, teeming with wild life. Notorious flesh-eating fish called piranha live in the Amazon River. The plateaux regions are generally hot in summer and warm in winter. Most of the plentiful rain falls in summer. The densely-populated south-eastern coast is hot all the year round and most parts have plenty of rain.

Many Amerind tribes live in the forests, parts of which have never been explored by Europeans. Although the Amerinds were the first known people to live in Brazil, today's population is mainly of European descent. Brazil also has many people of mixed origin. Most Brazilians live in the south-east along the country's Atlantic coast, where most of the towns and cities are situated. Most Brazilians are Roman Catholics.

Brazil is rich in timber and such minerals as diamonds, gold, iron ore and manganese. The country grows and exports more than half of the world's coffee. More than half the men work on farms. Others work in mines or in industries in the south-east.

Portuguese sailors settled in Brazil in the early 1500's. They married Amerind women, and their descendants, called *mamelucos*, developed large areas of the country. Between about 1580 and 1820, slave traders shipped about four million African slaves from Angola to Brazil. With African slaves settled on vast plantations, sugar became the chief export.

Many Portuguese settled in Brazil following the discovery of gold and diamonds there in about 1700. During the 1700's, the country's boundaries were extended southwards. Brazil peacefully gained independence from Portugal in 1822, and became a republic in 1889. Since 1889, Brazil has had several bloodless revolutions and many of its presidents have been military leaders.

Brazil is greater in area than Australia. It has as many people and almost as large an area as all the other South American countries together.

During the 1960's, Brazil's population soared to more than 90 millions. In an effort to open up the vast, mainly uninhabited interior, various governments developed Brasília as the country's new ultra-modern capital about 600 miles inland. They hoped that young Brazilians would want to leave such overcrowded coastal cities as Rio de Janeiro, the old capital.

Another serious problem faced by Brazil is the plight of the Indian tribes who live in remote areas. Contact with outsiders often causes great suffering. For example, epidemics of influenza have killed hundreds of Indians. To protect the Indians, the government has established large reserves where the Indians can live undisturbed.

Talking points

* Why did Brazil recently build an entirely new capital in the centre of the country? Discuss its advantages and disadvantages.
* Brazil, one of the largest countries in the world, could become one of the richest. List its assets and give reasons why these have not yet been fully exploited.

Brazil, unlike other South American countries, did not become a republic until the late 19th century. Why was this?

Articles to read

Amazon; Brasília; Coffee; Portugal; Rio de Janeiro; South America; individual South American countries.

A modern automated bakery. The loaves are being fed along conveyor belts to mechanical slicers.

Bread is one of our oldest and most valuable foods. It contains most of the substances we need for a healthy diet.

Most bread is made from flour obtained by grinding, or milling, wheat or rye. These two cereals contain a sticky substance called *gluten*, which helps to give bread its spongy texture. Rye has less gluten than wheat. Rye bread is therefore heavier than wheat bread. It is also very dark. The German bread pumpernickel is a well-known rye bread.

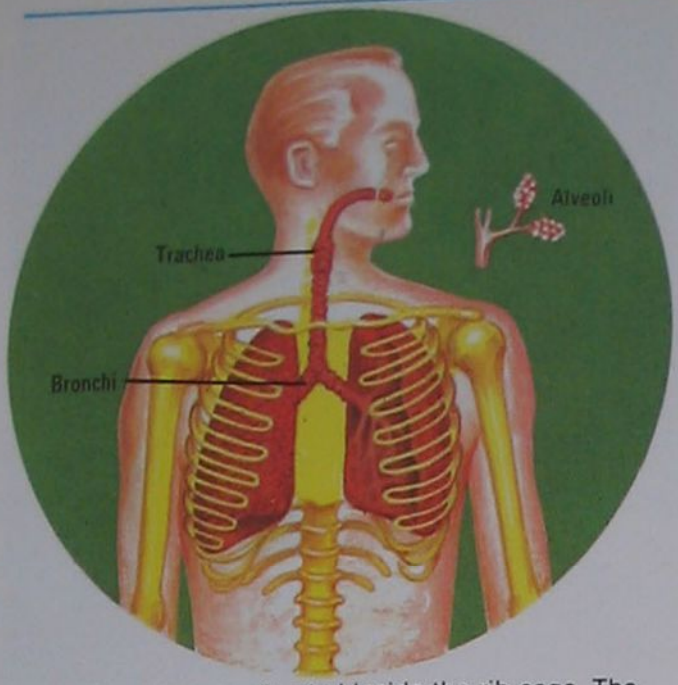
Whole-wheat flour used for making brown bread is obtained by milling the whole wheat grain, or *kernel*. To produce white flour only the inner, white part of the kernel is used.

In bread-making, flour is mixed with water, yeast and salt, and is often enriched with vitamins. The mixture is placed in a warm room where the yeast begins to ferment. Then more flour is added, and the mixture is kneaded into dough. The dough is placed into separate bread pans (tins) and baked in an oven.

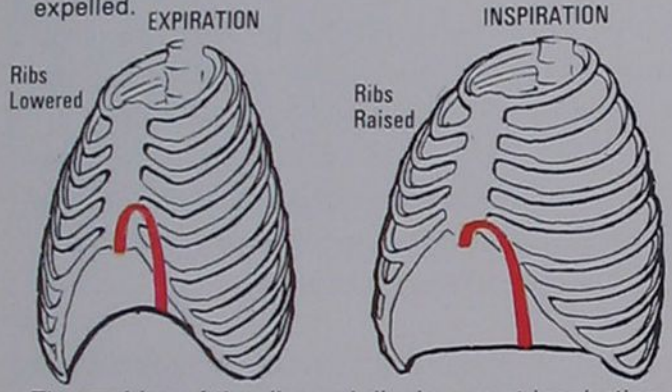
In the oven, the dough rises in the pans to make the familiar crusty loaves. Large bakeries use automatic methods to produce bread continuously.

Breathing Nearly all living things—both plants and animals—breathe. They take in oxygen, a gas, from the water or air they live in, and give off another gas called *carbon dioxide*. Breathing is vital to life, because the energy for all the functions of life comes from the breakdown of food with oxygen. This process is called *respiration* and carbon dioxide is produced as a waste product. The only living things that do not need to take in oxygen are certain bacteria (minute creatures that are not quite plants and not quite animals). These get their energy from other chemical processes.

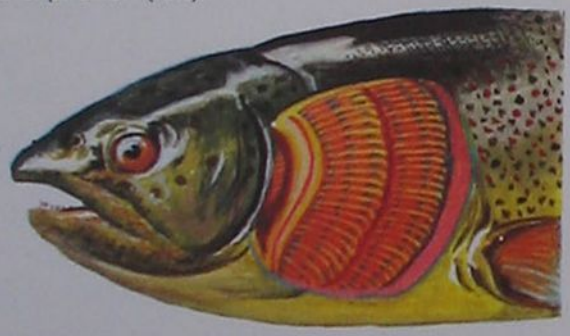
Small, simple creatures can get their oxygen directly from their surroundings. Amoeba, for example, consists of a single cell, and lives in water. Oxygen simply *diffuses* (passes) through the *membrane* (covering) of the cell, and carbon dioxide diffuses out.



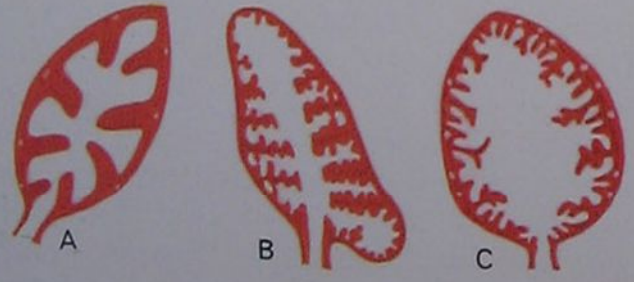
In man the lungs are situated inside the rib cage. The bronchi, which lead from the lungs, join together to form the trachea (the windpipe). The trachea in turn leads to the mouth and nose, where air is taken in or expelled.



The position of the ribs and diaphragm at inspiration (right) and expiration (left).



The gills of a fish are arranged on skeletal rods.



Diagrams showing in sections a lung of (A) a frog, (B) a lizard and (C) the mud-eel.

In larger animals, most of the cells are too far from the surface for this simple diffusion process to work. They have to have special organs where the diffusion takes place, and may have a blood system that carries the oxygen and carbon dioxide to and from the rest of their body. (See Blood.)

Insects have a blood system, but a network of tiny tubes carries air directly to all parts of their bodies. In fishes, the special breathing organs are the *gills*. These exchange oxygen and carbon dioxide with the water flowing over them.

Amphibians, reptiles, birds, and mammals all have *lungs*. Amphibians also breathe through their skin, especially when they are hibernating. The lungs of birds are small, but air sacs act as pumps and circulate large quantities of air.

The lungs of mammals, such as man, are the most highly developed. A pipe called the *trachea* takes air downwards from the back of the throat to the lungs, which fill the chest cavity. The trachea divides into two *bronchi*, one serving each lung. The bronchi divide again and again into tubes which end up in tiny pockets called *alveoli*. The oxygen and carbon dioxide diffuse through the thin walls of the alveoli to and from the blood in tiny blood vessels surrounding them. Expanding and contracting the chest cavity by moving the rib cage and the diaphragm draws air in and out of the lungs.

Brecknockshire, also called Breconshire, is a mountainous inland county in south-eastern Wales. Its county town is Brecknock (Brecon), and its area is 733 square miles.

The county has much beautiful forested scenery, with three mountain ranges separated by the valleys of the rivers Yrfon and Usk. The Brecknock Beacons in the south rise to 2,907 feet at Pen y Fan—the highest point in South Wales. The southern half of the county is a national park. Agriculture and declining coal-mining are the main sources of income.

Breeding is a way of producing better kinds of plants and animals. Farmers, pet-breeders, and flower growers have all improved their stock by careful breeding.

All parents pass some of their characteristics on to their offspring. This is the basis of heredity. By choosing parents with desirable features, the breeder can gradually build up a stock of plants or animals all having those features – it might be good wool yield in sheep, or heavy cropping in broad beans.

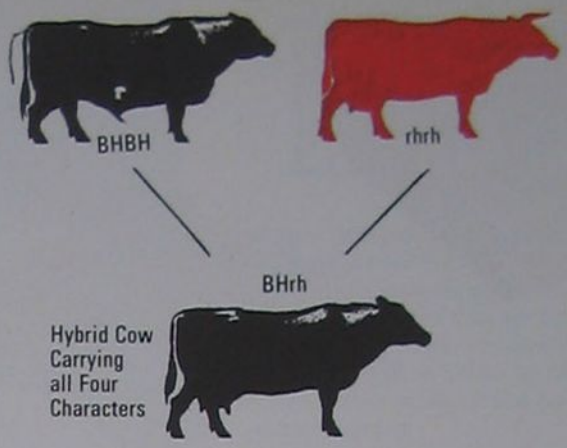
New strains or varieties of plants or animals can sometimes be obtained by pairing two unlike parents. This is known as *hybridization* and it may result in offspring showing new combinations of features. If the parents are very different, the offspring may not be able to reproduce – they may be *sterile*. The mule is a good example. It is the offspring of an ass and a mare (female horse) and it is a good working animal, but it cannot breed. Hybridization between two varieties of one species, however usually produces fertile offspring.

Another way in which new strains may arise is by *mutation*. This is a change in some of the sex cells and it brings about abnormal offspring. Most of these probably die, but some of the abnormal features may be useful and the new strain may survive. Many of our cultivated crop varieties probably arose in this way.

When once the breeder has obtained a new strain he must begin the second stage of the breeding programme – *selection*. By selecting the best individuals for breeding he can build up numbers and improve the strain still further.

Using these methods farmers have bred cattle with better milk yields, sheep with better fleeces, wheat that can survive cold climates, cereals with stronger stalks which can withstand wind, and many other useful varieties.

The breeders of racehorses and pedigree dogs also practise selective breeding and carefully choose the parents to produce the best offspring.



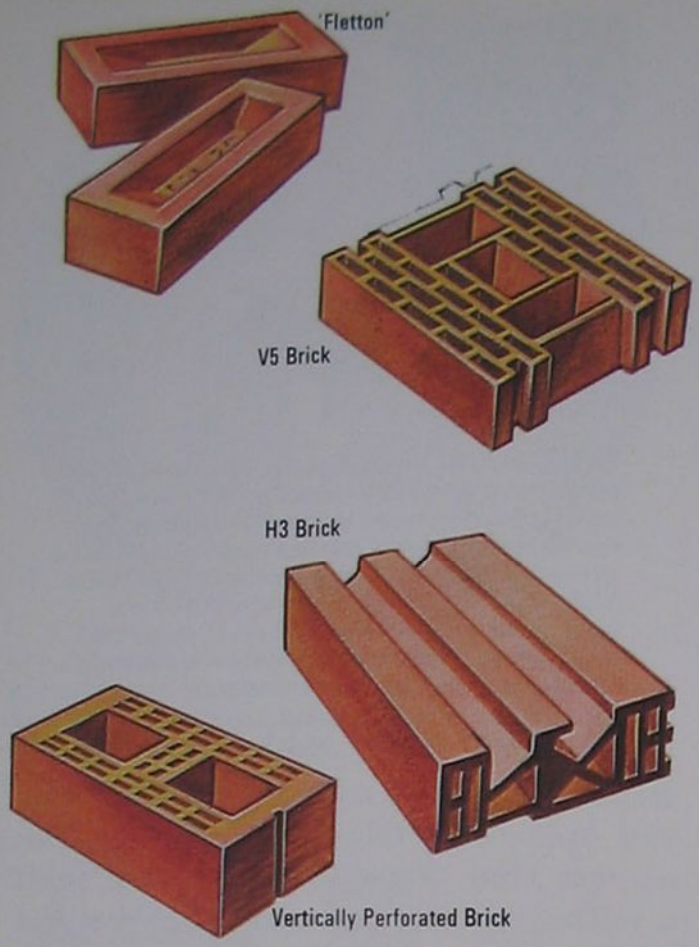
Each animal has a pair of genes. An animal's characteristics are determined by its genes. It inherits these from its parents. For instance, it has two colour genes, one from each parent. Some genes are stronger or more dominant than others. In the diagram above the genes for the colour black (B) and hornlessness (H) are stronger than those for red (r) and horned (h). So the offspring of this match is black and hornless.

Bricks have been used for building huts and houses for thousands of years. The earliest kind of bricks were made from a mixture of clay and straw that was put into moulds and baked in the sun. During building, the bricks were joined together by mud. This method of making bricks is still used today in hot, dry countries, such as Mexico. There, sun-baked bricks are called adobe.

In modern methods of brick-making, clay is crushed, ground fine, and then sifted. A machine with revolving blades mixes the clay thoroughly with enough water to make it into a stiff paste. Then the clay is extruded, or squeezed, through a rectangular hole to form a long ribbon. Wires cut the ribbon into brick lengths. The raw bricks have to be dried before they can be fired, or burnt, in the high-temperature ovens, or kilns.

The dried bricks are heated in the kiln to 1,000 °C or more. At this temperature, the particles of clay begin to fuse, or melt together, and make the brick strong. Some bricks are so burnt that their surface is glazed, or glass-like. Glazing is also done by throwing salt into the kiln fires.

The size of bricks varies from country to country. The standard British brick



is about 9 in. × 4½ in. × 2½ in., and this is a fairly average size.

To build a wall, layers, or *courses*, of bricks are laid flat-side down one on top of the other and bound together with mortar. Mortar is a soft paste containing cement, sand, and lime. The bricks are laid so that they overlap to stagger the vertical joints.

Bridges are among the most spectacular of man-made structures. They carry traffic high above wide river estuaries and deep valleys. Roads and railways no longer have to follow the rise and fall of the land or the line of the coast.

The simplest and oldest kind of bridge is the *beam* bridge, which consists of a timber or steel beam supported at the ends by piers. The length, or span, of the bridge cannot be too great, otherwise the beam will sag and collapse in the middle. Longer beam bridges can be built by supporting the beam with several piers along its length.

The Sydney Harbour bridge is the largest steel arch bridge in the world (although the Bayonne bridge, New Jersey, U.S.A. is longer by 25 inches). The main span is 1,650 feet long and the bridge is 160 feet wide. It carries eight lanes of roadway and two railway lines. The Mackinac Straits bridge, Michigan, U.S.A. is the longest bridge in the world and measures 19,203 feet overall. The Royal Gorge bridge over the Arkansas River, Colorado, U.S.A. is the world's highest, being 1,053 feet above the level of the water. Plans have been made to build a suspension bridge across the Messina straits, Italy. The main span will be 9,000 feet which is double the present world record.

The *arch* bridge can be built with a greater span than the simple beam bridge. The weight of the bridge is transmitted at an angle down both sides of the arch. The Ancient Romans were expert builders of stone-arch bridges and many are still standing. The longest spans are about 100 feet.

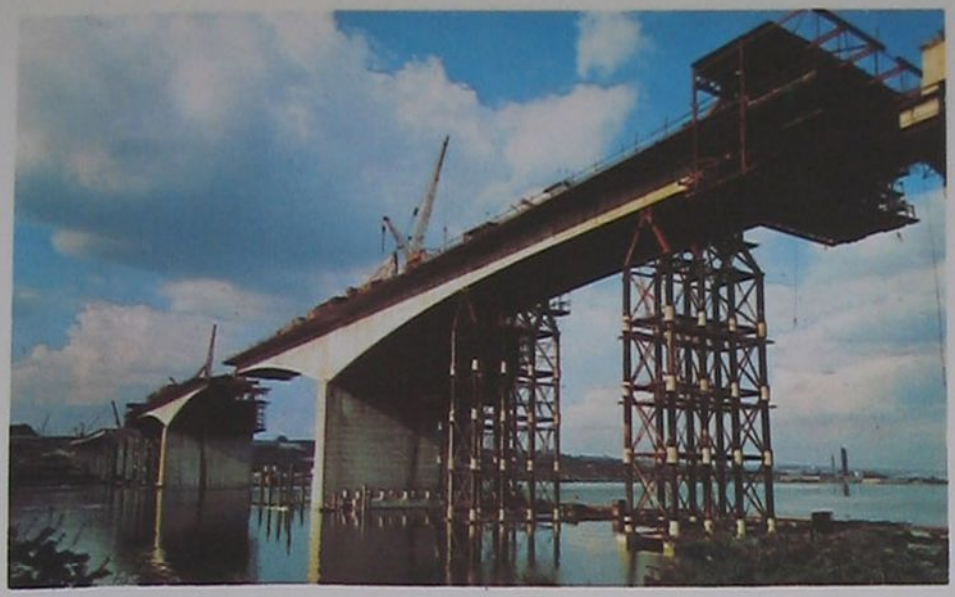
With modern materials, arch bridges can be many times bigger. In Australia, the Gladesville concrete-arch bridge has a span of 1,000 feet, and the steel-arch Sydney Harbour Bridge has a span of 1,650 feet.

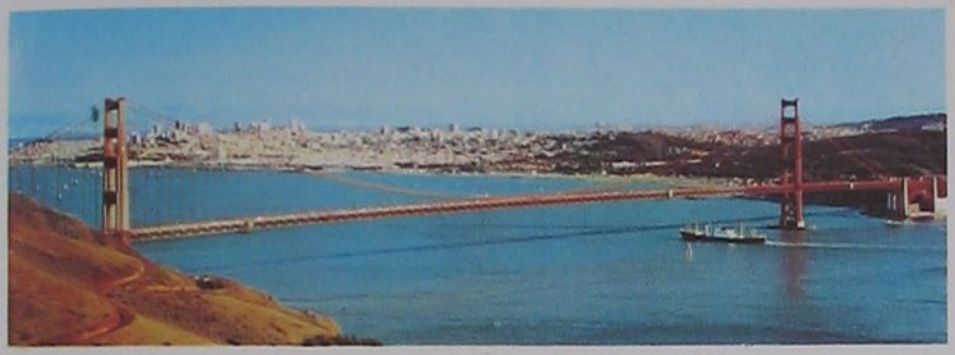
The *cantilever* bridge is rather different from the other types of bridge because it is not supported evenly along its length. It consists of two steel beams projecting towards each other from opposite banks of the river. The beams are anchored at the bank edges and supported in the middle by piers. But they overhang in mid-stream. They are usually connected by another beam called the suspended span.

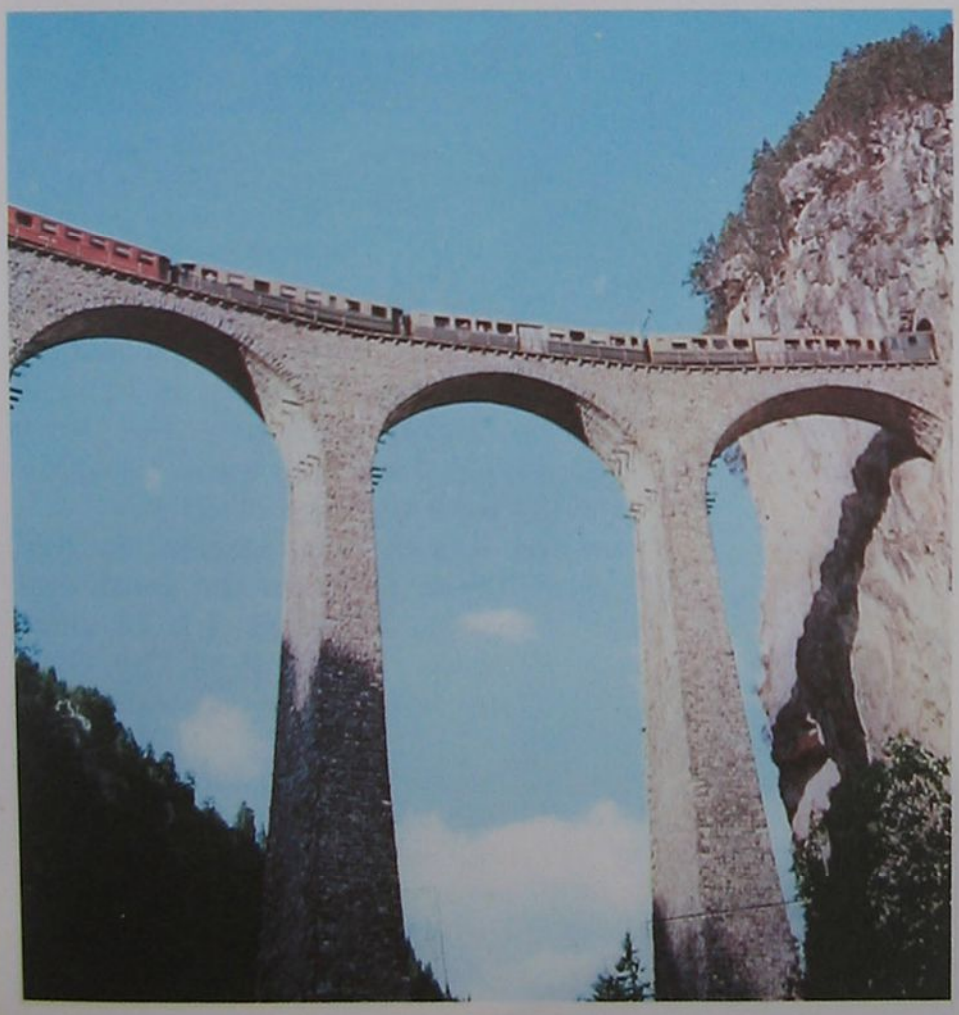
The Pont de Quebec (1,800 feet) in Canada and the Forth Rail Bridge (1,710 feet) in Scotland have the longest cantilever spans in the world.

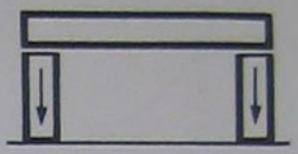
Spans of more than twice as great as the cantilever bridge can be achieved by the most magnificent bridge of them all —the *suspension* bridge. In this kind of bridge the road literally hangs in the air from a pair of cables carried by two high towers.

These suspension cables are made up of thousands of strong steel wires bundled tightly together. Some are three feet

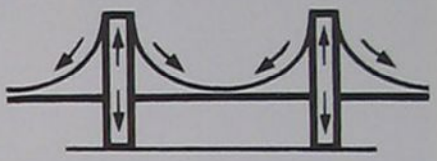






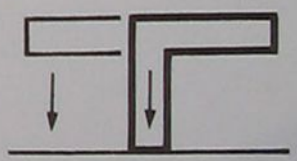


Beam bridges can be built over rivers which are not too deep. The several piers needed to support them can be built without difficulty. The weight of the bridge is taken by the piers at the ends of the beam (see diagram).



The weight of a suspension bridge rests on the two towers which carry the suspension cables supporting the bridge deck. The Golden Gate Bridge, which spans the entrance to San Francisco Bay, is of this type.

Some arch bridges, such as this stone railway bridge in Switzerland, are spectacular structures. It is the shape of the arch that gives the arch bridge its strength. The load is carried down the arch to the supporting piers and the sides of the valley.



Most of the weight on a cantilever bridge is taken by the central support (see diagram above). The Forth rail bridge, on the right in the picture on page 192, is of this type.

Spinning the wire suspension cables of the Forth road bridge, completed in 1964. In the background is the Forth rail cantilever bridge of 1890.

thick. The road hangs from the cables by rods called suspenders. The cables pass up and over the towers and then down again to firm anchorage points. The bridges with the longest suspended spans are the Verrazano Narrows Bridge (4,260 feet) in New York and the famous Golden Gate Bridge (4,200 feet) of San Francisco.

Other kinds of bridge include those which move out of the way of passing ships. *Swing* bridges move on a central pivot. *Bascule* bridges move up and down. The best-known bascule bridge is Tower Bridge in London, which has double opening leaves.

Talking points

* See how close to home you can find an arch bridge, and a cantilever bridge. Can you find out when they were built?
* How many different uses for bridges can you think of? You should be able to think of 12 at least.
* Do you think it would be better to link Britain with the continent of Europe by a bridge or a tunnel?

Articles to read

Architecture; Aqueduct; Building construction; Brunel; Canals; Railways

Brisbane is the capital of Queensland and the third largest city in Australia. It has 813,300 people. The city is large in area, with suburbs ringing the town centre. Sunny skies and warm temperatures make for a pleasant climate.

Brisbane is a thriving seaport, located on the Brisbane River in the south-east part of the state. Although it is 14 miles from the ocean, dredging of the river bottom gives large ships access to its docks.

Brisbane is the market for farms and ranches to the north and west. From it, meat, butter, wool, refined sugar and tanned hides are exported. Coal comes in from Ipswich, and oil from Moonie. Besides refineries and food-processing

plants, the city has steel mills, textile mills, motor-car factories and cement works.

The city's attractions include many parks and gardens, an impressive City Hall, an art gallery, a museum and libraries. The University of Queensland is located in the city.

The Brisbane area was explored in 1823. In the following year a prison colony was established there, which lasted until 1839. Later, the free settlement developed until it became the capital of the newly established colony of Queensland in 1859. The city was named after Sir Thomas Brisbane, one-time governor of New South Wales.

The crest of the city of Bristol, from an old manuscript. The ship symbolizes the city's maritime importance. The old name for Bristol was Bristowe, and this has survived as a surname.

Bristol is one of Britain's most important seaports. The population of the city and its suburbs is over 425,300. The city dates back to Anglo-Saxon times. It lies on the River Avon, on the borders of Gloucestershire and Somerset, but has had special county status since the late 14th century.

Bristol was once a centre for Atlantic trading, but today it is also a thriving industrial centre. Printing, shipbuilding, aircraft manufacture, and other engineering enterprises are located here. The city also has a university, an art gallery, and a medieval cathedral.

British Columbia is the most westerly province in Canada, bordering the Pacific coast. It has a population of 2,187,000, mostly of British, German, French or Dutch origin. There are also about 45,000 Indians. Nearly half the population of British Columbia lives in or near the city

The new City Square in Brisbane. The clock tower belongs to City Hall, opened in 1931. Its auditorium can seat 2,500 people and is used for concerts.

of Vancouver, which has one of the finest natural harbours in the world and is the western terminus of the Canadian Pacific and National Railways. The capital, Victoria, is on Vancouver Island.

The area of British Columbia is 366,255 square miles, much of which is covered with thick forests. The province provides more than half Canada's lumber, and its next most important industry is mining. The land is rich in zinc, copper, lead, iron ore, natural gas and petroleum, and asbestos.

Tourism is important to British Columbia which has some 35 national and provincial parks. There are three main mountain ranges—the Rockies, the coast mountains, and the interior ranges—and the mountainous coast has many sheltered harbours and inlets.

The first known European to reach British Columbia was Alexander Mackenzie, in 1793. People swarmed there after gold was discovered in 1851, and in 1871 it became a Canadian province.

British Isles is a group of islands off the mainland of western Europe. It consists of the United Kingdom of Great Britain and Northern Ireland, and the Republic of Ireland. The Isle of Man and the Channel Islands are British dependencies. (See Channel Islands; England; Ireland; Scotland; United Kingdom; Wales.)

The British Isles has five main mountain areas. The Highlands of northern

Docks at Stewart, in northern British Columbia. The province's wooded mountain slopes provide most of Canada's valuable lumber.

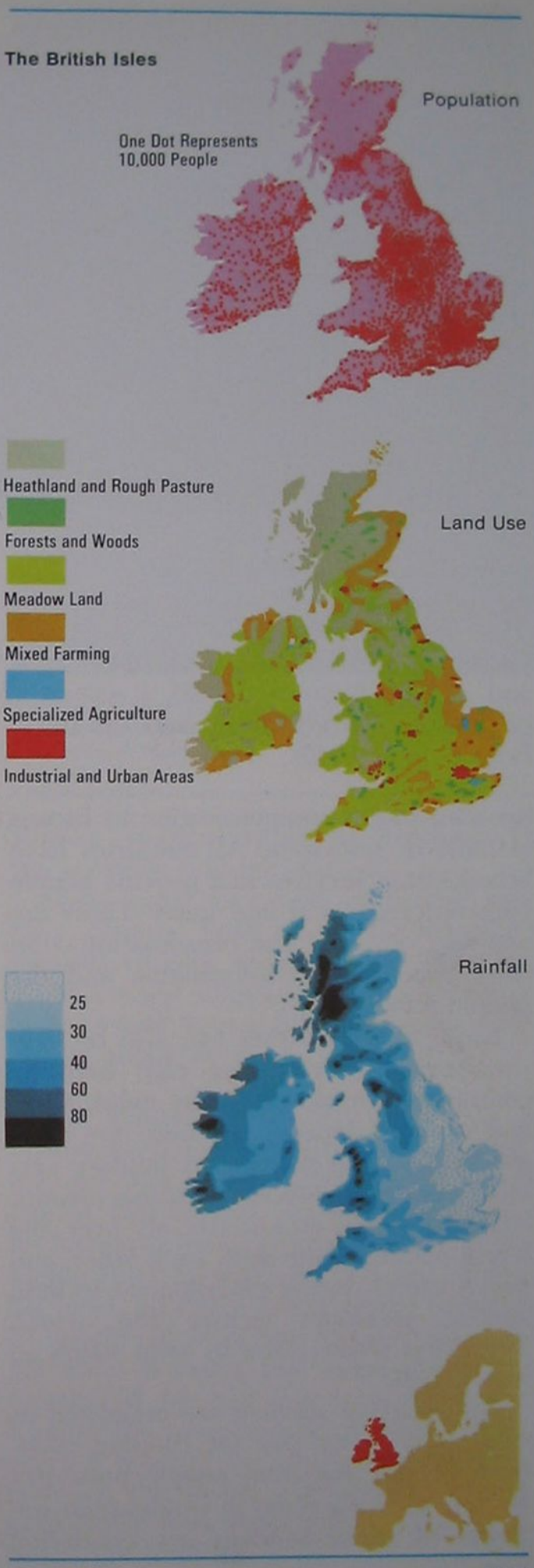
Scotland include the region's highest peak, Ben Nevis (4,406 feet above sea level). An upland area separates England and Scotland, and a ridge, the Pennine Chain, runs halfway down the centre of England. In north-west England is the Lake District. The mountains of northern Wales include Snowdon (3,561 feet). In Ireland, the south-west has peaks of 3,000 feet.

Fertile plains occupy central Scotland, midland and southern England, and the whole of central Ireland. Most of the farmland and also the industrial cities of the British Isles are in these areas.

The Shannon in the Republic of Ireland is the longest river in the British Isles. It flows into the Atlantic Ocean in western Ireland. Great Britain's longest river is the Severn. Other major rivers include the Thames and Humber in England and the Clyde and Forth in Scotland.

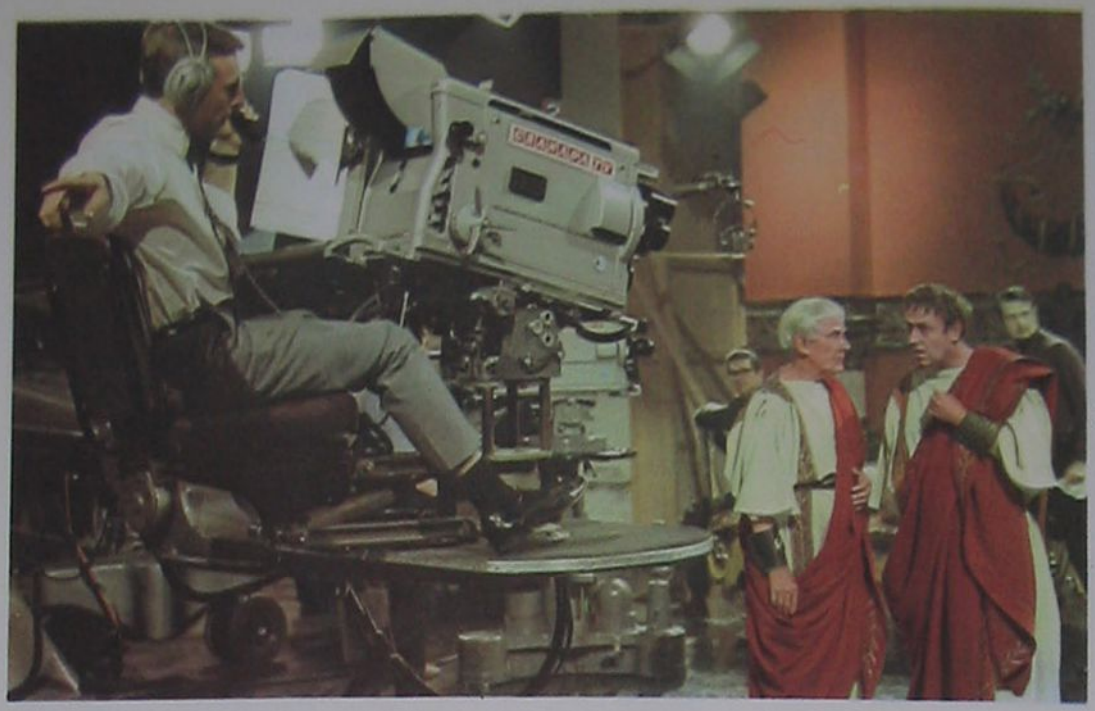
Most of Scotland's lakes, called *lochs*, lie in the Highlands. The largest is Loch Lomond. England's best-known lakes lie in the Lake District, in the north-west. Lough Neagh, in Northern Ireland, is the largest lake in the British Isles.

The British Isles has a generally mild, rainy climate. Rainfall is greatest in mountainous areas and decreases from west to east. Scotland and northern England have cold winters and fairly cool summers, with between 30 and 80 inches of rain. Most of England and most of Wales have cold winters and warm summers, with less than 30 inches of rain in the east. South-western England and south-eastern Ireland have milder winters. Northern, central and south-western Ireland and western Wales have mild winters and cool summers, with up to 50 inches of rain.



Britten, Edward Benjamin (1913-), an English composer, conductor and pianist who after World War II gained a world-wide reputation. In 1948 he founded the Aldeburgh Festival, in Suffolk.

Although gathering inspiration from many sources, Britten's works reveal a



Actors taking part in a television production.

directness and simplicity, and a genius for setting words to music. Among his best loved compositions are *A Young Person's Guide to the Orchestra* (1946), and *A War Requiem* (1962), a setting of poems by Wilfred Owen; and the opera *Peter Grimes* (1945).

Broadcasting is communication by means of radio or television. All countries have broadcasting services that provide people with entertainment and news. These are one-way services. The broadcasting company transmits its information and the people receive it.

Radio and television can also be two-way services. Telephone calls between continents are often sent by radio. Ships and aircraft depend on radio for navigation, and the police and military services use radio to direct their movements. Amateur radio enthusiasts all over the world communicate with each other, and prove useful during emergencies to flash special messages across the world. Television is also used to keep watch on heavy traffic.

Broadcasting services are organized in two ways. Some pay for running costs from licence fees that people must pay by law to use a radio or a television set. Some of these services are controlled by governments. Some, such as the BBC in Britain, can provide whatever service they think best. Other broadcasting services raise their money by broadcasting advertisements. No licence fee is charged, but the programmes are often controlled or influenced by the advertisers.

Talking points

* What differences do you think the coming of broadcasting has made to people's lives?
* Do you think that broadcasting should be controlled by private companies or by the State? Give shortcomings and advantages of both systems. Consider programmes sponsored by advertising and censorship.
* Many people thought television would kill sound broadcasting. This is not so. For what purposes is radio better than television?
* Do you think that the showing of violence on television encourages people to behave violently themselves? And do news items showing violence or brutality shock people or make them indifferent?

Articles to read

Communications; Marconi; Radio; Television.

Brontë was the name of three English sisters who became famous writers. Charlotte Brontë (1816-1855), Emily Brontë (1818-1848), and Anne Brontë (1820-1849) wrote novels that are among the classics of English literature.

The Brontë sisters were the daughters of an Irish clergyman, Patrick Brontë, who also had two older daughters and a son. The family lived at Haworth, on the bleak, lonely Yorkshire moors. Mrs Brontë died while the children were young, and the two eldest girls died a few years later. From an early age the remain-

Objects made of bronze turn a beautiful deep brown with time, or become covered with a greenish film known as a patina. After such a film has formed bronze corrodes only very slowly, so bronze objects last hundreds of years.

ing girls developed their talent for writing poems and making up stories.

In 1847 all three produced their first novels. *Jane Eyre*, a largely autobiographical work by Charlotte, was an immediate success. It is considered her masterpiece. Emily's *Wuthering Heights*, though too shocking for its time—it dealt with passion and hate—is seen today as a great book. Anne's book was entitled *Agnes Grey*. The sisters published these and later works under the pen names of *Currer*, *Ellis*, and *Acton Bell*, because few people in the 1800's would buy books written by women.

A portrait of Anne, Emily and Charlotte Brontë by their brother Patrick Branwell Brontë. All three taught for a time but with little success.

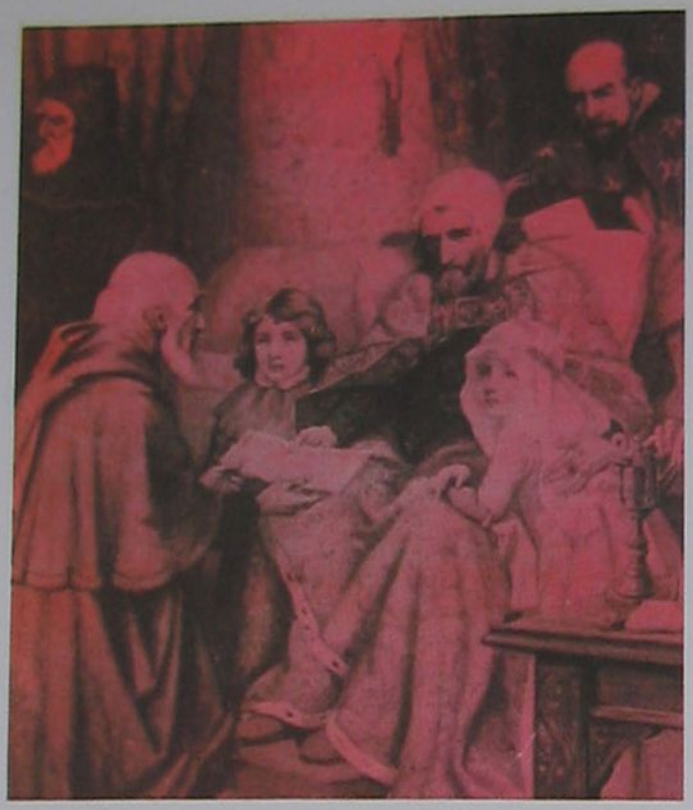
Bronze is an alloy of copper and tin that has been used for thousands of years. The Bronze Age was a time when bronze was man's most important metal for making tools and weapons.

Bronze is hard and resists corrosion well. It is a favourite material for artists. Bronze statues withstand exposure to the weather without damage.

Many coins are made of bronze, but they contain little tin. Some so-called bronzes contain no tin at all. They are other copper alloys. Aluminium bronze is hard and strong. Silicon bronze withstands attack by strong chemicals.

A bronze helmet of the First Century A.D.

Bruce, Robert (1274-1329), was a king of Scotland who freed his country from English rule. For many years Bruce struggled against the English. According to legend his fortunes changed one day when he was hiding from his enemies in a hut. Above his head, he saw a spider trying to swing by its thread from one beam to another. Six times it swung and failed. Bruce remembered he had failed to defeat the English the same number of times. At its seventh attempt the spider succeeded in reaching the beam. The spider's efforts gave Bruce new hope, and he went on to defeat the English.



Robert Bruce granting a charter to the city of Edinburgh.

Early in his life Bruce swore allegiance to King Edward I of England. But in 1306 Bruce had himself crowned king of Scotland. The English defeated him in battle, and Bruce went into hiding. He later fled to Ireland. But he returned the next spring when Edward II had become king of England. He defeated the English and spent the next two years regaining control Scotland. His great victory over Edward II's troops at the Battle of Bannockburn in 1314 ended English control of Scotland. King Edward III of England recognized Bruce as king of an independent Scotland in 1328.

Brunei, a state on the north-west coast of the island of Borneo, has been a British protectorate since 1888. It has an area of 2,226 square miles, and a population of 130,000. Its people are mostly Malays, but many Chinese also live there. Most people follow the Muslim religion. The head of the government is the Sultan. Brunei's capital is also called Brunei.

This map shows the location of Brunei.

Brunei's climate is tropical, with heavy rains in the interior. Farmers grow sago, coconuts, rice and other crops. There are also rubber trees and hardwood forests. The country's wealth comes primarily from petroleum and natural gas.

Brunei was once a headquarters for slave traders and pirates.

Brunel was the name of two famous engineers, father and son.

Marc Isambard Brunel (1769-1849) was born in France. He came to England in 1799 and set up a factory in Portsmouth for making ships' blocks. It was one of the first mass-production schemes. His inventions included machines for sawing

Isambard Kingdom Brunel, standing in front of the chains of his steam ship the *Great Eastern*.

wood and for making boots, books and knitted stockings. In 1825 he began the construction of the world's first underwater tunnel, which ran beneath the Thames in London.

Isambard Kingdom Brunel (1806-1859), born in Portsmouth, became known as the builder of several famous bridges, including the Clifton suspension bridge over the River Avon at Bristol. He supervised the building of the railway from London to the west of England. Brunel also built three trans-Atlantic passenger steam ships. The last of them, the *Great Eastern,* was launched in 1858 and was the largest ship built in the 19th century. Her hull was of iron and she was powered by paddles and screws, as well as having six masts for sails.

Brussels (pop. 1,543,000) is the capital of Belgium and its largest city. The city has many ancient and medieval buildings famous for their architecture. These include the old town hall, the Church of St Gudule, and medieval guild-halls. From the Grand' Place, a market square in the centre of the city, avenues stretch out to boulevards that ring the city. The city has many fine art galleries and museums, and is an important centre of learning.

Brussels is also an important rail junction, with large industrial and commercial interests. In its early days the city lacked a direct link with the sea, until the Willibroek Canal, built in the mid-16th century, linked it with the North Sea.

Founded in the 6th century, Brussels became the capital of Belgium in 1830. The city has twice been occupied by foreign troops in recent times. It was captured by the Germans in the First World War (1914-18) and again in 1940 until liberated by Allied forces in 1944.

Bucharest has been the capital of Rumania since it was formed in 1861, by the joining of the provinces of Walachia and Moldavia.

The Hôtel de Ville (Town Hall) of Brussels.

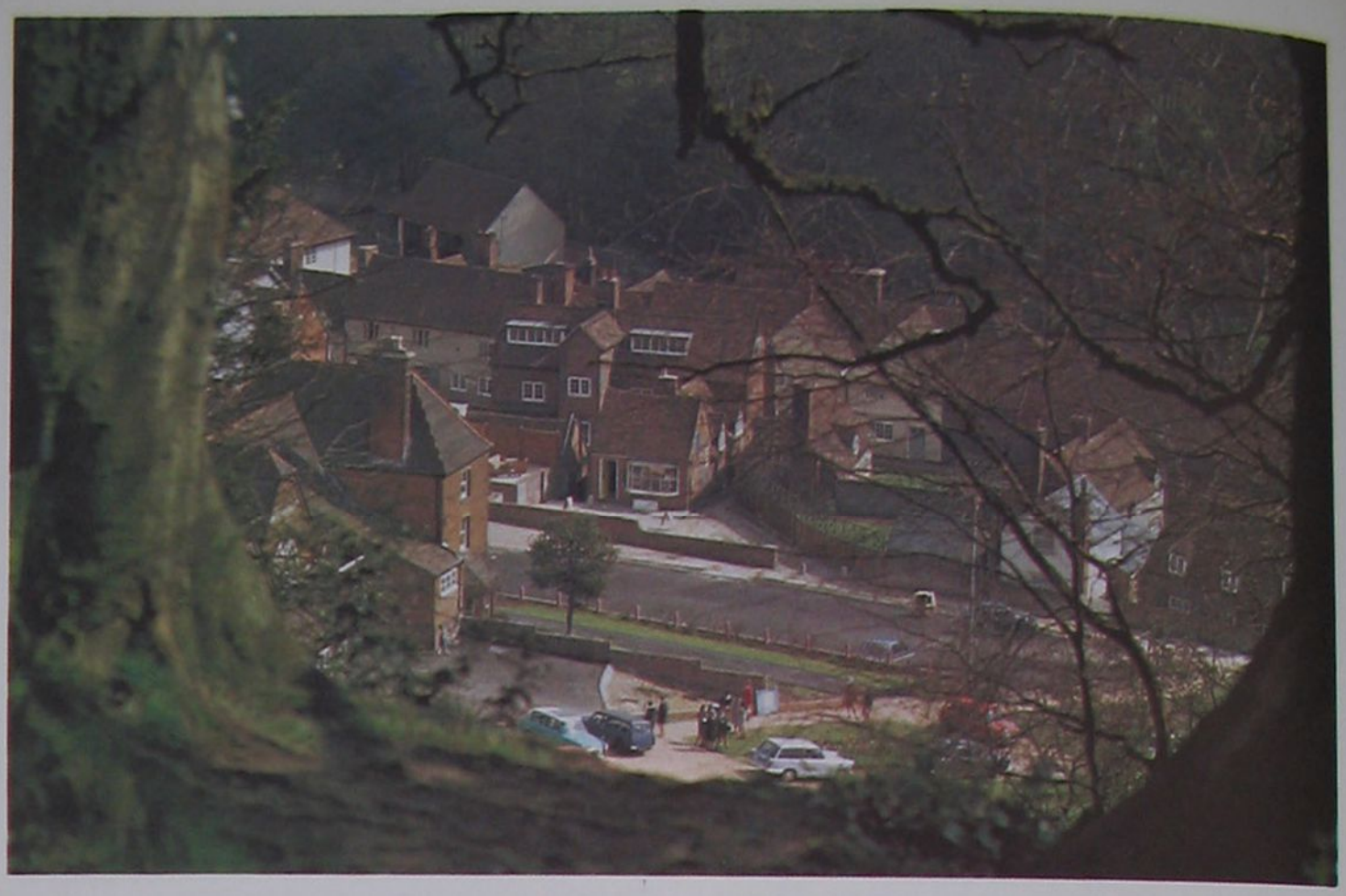
It is also the country's largest city, with a population of 1,511,388. It is the religious and cultural centre of Rumania.

Bucharest was founded around the 1300's but did not develop into a large city until the 1800's. Its heritage from the past includes some winding streets and old churches, but mostly it is a city of broad avenues and modern blocks of flats.

Important industries in Bucharest include the manufacture of chemicals, transport equipment and textiles. It also has oil refineries and tanneries.

Buckinghamshire, an inland English county to the north-west of London, is noted for the remains of an ancient forest of beech trees, called Burnham Beeches. Buckinghamshire's county town is Aylesbury, and its area is 749 square miles.

The Chiltern Hills, entering the county in the south-west and extending in a north-easterly direction, are a contrast



Above: The village of West Wycombe in Buckinghamshire. Opposite: A 16th-century miniature showing the Turks besieging Budapest.

to the rest of the gently rolling, well wooded countryside. The chief rivers are the Thames (with its tributaries the Colne and the Thame), the Ouse, and the Ousel. The main towns are Aylesbury, Slough, Marlow, High Wycombe, Beaconsfield, Amersham, and Eton (with its famous school). Agriculture is the principal occupation, but the beech forests in the south have encouraged a furniture industry centred on High Wycombe.

Budapest is the capital and chief city of Hungary. It has a population of 2,007,000. In 1873, the separate towns of Buda and Pest, on opposite banks of the River Danube, were joined to make one city. Many of Budapest's beautiful old buildings and all of its bridges were destroyed during World War II. The city was the scene of uprisings against Hungary's Communist regime in 1956.

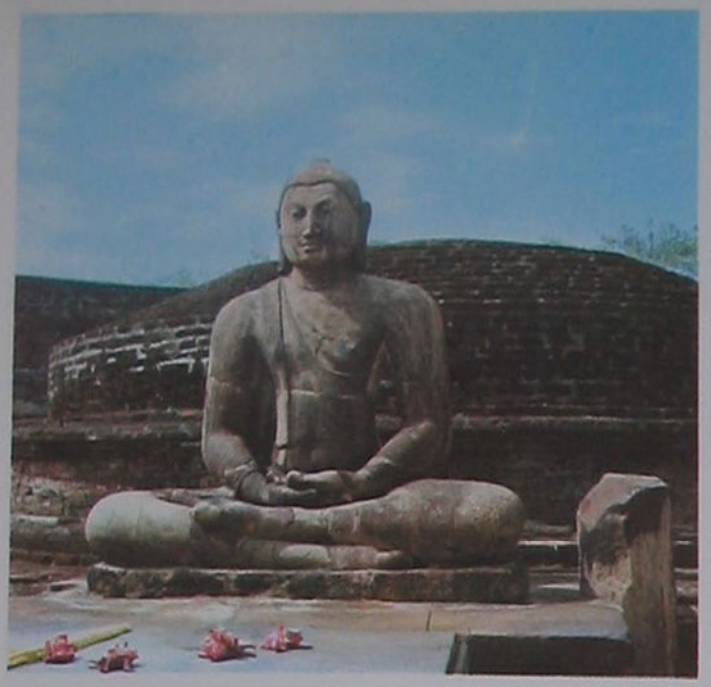
Budapest is a commercial centre for the fertile plain nearby. Grain is milled there, and wine, hides, meat and tobacco are brought to market. Factories in the city and suburbs produce iron and steel, chemicals, cloth and food products. Its mineral springs are well known throughout Europe, and it has a university.

Budapest is a very old city. It once belonged to the Romans and later to the Turks. It came under the rule of the Habsburgs in 1686. (See Habsburgs.)

Buddha was a great religious teacher who lived in India five hundred years before the birth of Christ. *Buddha* means 'the enlightened'. It is the name given to Siddhartha Gautama by his followers.

The son of a rajah, or prince, Siddhartha Gautama was raised in great luxury. But neither a beautiful wife nor all the riches of his father's court were enough to make him happy. He was deeply troubled by the suffering he saw around him, and wanted to find a way to bring peace to his people's minds.

Photo: Sonia Halliday



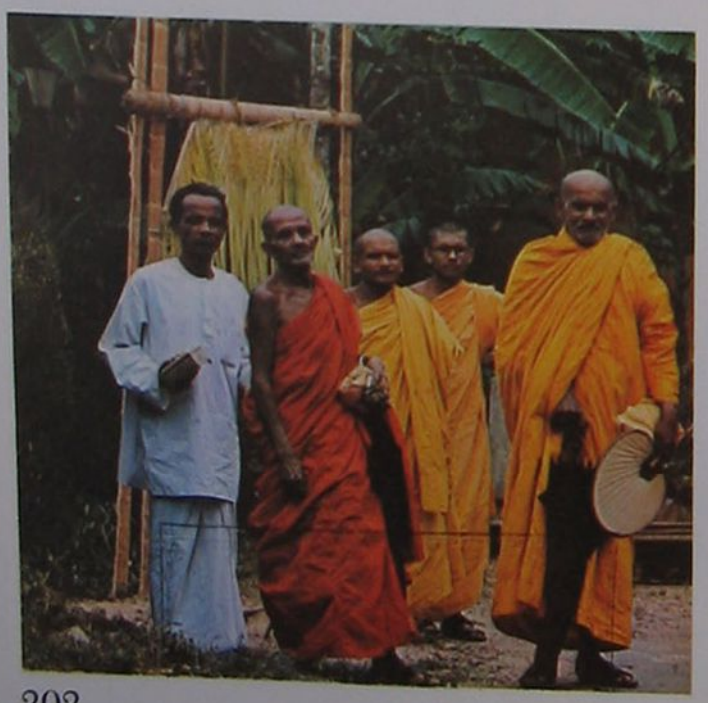
A huge statue of the Buddha in Japan.

When he was thirty years old, he left his home, his family, and all his possessions to begin his spiritual quest. For six years he lived the life of a hermit, praying, fasting, and exercising rigorously, but still his mind remained restless. Then he remembered that as a boy he had often found peace sitting in the shade of a tree. He went to a river bank and sat for a long time beneath a sacred fig tree, neither moving nor thinking, but letting the peace of the river wash over his troubled mind.

When at last he arose he had found his answers. They became the foundations of the Buddhist religion which spread throughout the eastern world.

Buddhism is still a major religion in China, Japan, Tibet, Ceylon, Burma, and Thailand. Buddha is not worshipped as a god, but admired as a great teacher. (See Buddhism.)

Many Buddhist monks wear distinctive saffron robes.



Buddhism is the religion of at least 170 million people of central, eastern, and south-eastern Asia. Most Buddhists do not worship a god, but they seek to attain the state of Enlightenment which Siddhartha Gautama, known as the Buddha, attained.

The Buddha taught a Middle Way between strong desires and exaggerated austerity. Those who follow this way can escape desires and eventually attain Enlightenment. The Middle Way is also known as the Noble Eightfold Path. According to this code of conduct, people should have Right Views, Right Resolve, Right Speech, Right Action, Right Livelihood, Right Effort, Right Concentration, and Right Contemplation.

The Buddha taught that all things are changing and nothing is permanent. Buddhists believe that all creatures are born many times. The connection between each life is not the soul but *karma* (deeds). The evil of man's past life explain the sufferings of his present life. If a man can attain Enlightenment through the Eightfold Path, he may reach *Nirvana*, an exalted state in which there is no desire, no suffering, and in which there is no existence as we know it.

There are two main Buddhist groups, the *Theravada* and *Mahayana*. They differ about the nature of Enlightenment. Many Buddhists spend a period as monks in monasteries, particularly in Burma and Thailand. They are peaceful people because they believe that taking life is wrong. They tolerate other religions.

The Buddha was born at Lumbini in Nepal in 563 B.C. After achieving Enlightenment, he preached his first sermon at Sarnath in northern India. He made many converts during his life. He died about 483 B.C.

Budget A budget is an estimate of future income and future expenses. Governments and businesses prepare a budget each year so that they can plan for the year ahead. Many people make budgets for themselves. They calculate what their income will be during the coming three months, or six months, or year, and try to foresee what expenses they will have. In this way they make sure of not spending more than they earn. A well-prepared budget helps to avoid careless spending and getting into debt.

A Gladstone budget box (nineteenth century).

A company's budget is prepared by its accounts department after collecting estimates of future income and expenditure from all departments of the company. The national budget is a country's plan of income and expenditure that the government prepares every year. It contains details of the ways in which the government intends to obtain *revenue* (income). It also gives details of short-term and long-term expenditure and estimates the total expenditure and the sources of finance.

In Britain, for example, each government department informs the Treasury once a year of its plans for expenditure during the next twelve months. Departments that have revenue also inform the Treasury of their estimated revenue for the year ahead. From these figures, the Chancellor of the Exchequer is able to prepare a budget for the country. He may find that the estimated expenditure is more than the estimated revenue. He then has to cut the expenditure on some items or increase the revenue by higher taxes or new taxes.

Buenos Aires is the capital and chief port of Argentina, in South America. It is the largest city in the southern hemisphere. With its suburbs, the city houses more than a third of the country's people, and has a population of more than 9 million. It spreads over some 77 square miles of the west bank of the *estuary* (broad mouth) of the Rio de la Plata, about 150 miles from the sea.

In spite of its many factories, including a large number of meat-packing plants, Buenos Aires is a beautiful, almost completely modern city. It was founded in 1536 by the Spaniards. It became the capital of the Argentine republic in 1853, and was rebuilt and modernized from the beginning of the 1900's.

When the first Spanish explorers landed on the present site of Buenos Aires, they noticed how fresh and healthy the air was. So the city was given the name 'Good Air'—in Spanish, Buenos Aires.

Buffalo are the large wild oxen of Africa and Asia. American 'buffalo' are really bison (see Bison). The African and Asian buffalo are not closely related, but they both look like big, stockily built cattle. Asian buffalo enjoy wallowing in water, and are often called *water buffalo*. These animals have huge horns, sometimes over six feet from tip to tip. They have been tamed in many parts of Asia, and are used to pull carts and ploughs.

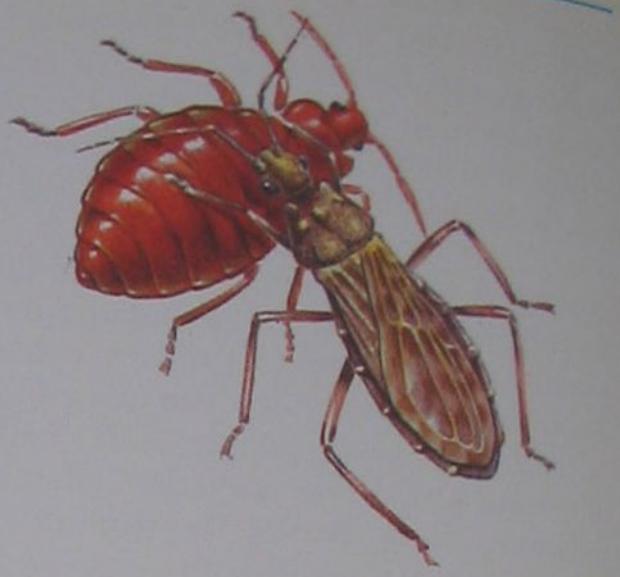
Cape Buffalo in Kruger National Park, South Africa. These animals can be extremely dangerous. The Asian buffalo is slightly larger and more docile, and has been domesticated for centuries. It has been successfully introduced as a draught animal into a number of Mediterranean countries.

African buffalo have shorter but more sharply curved horns. They are black, as opposed to the greyish-black of the Asian species. Both eat grass.

Buffalo Bill (1846-1917), was a scout, buffalo hunter and showman. His real name was William Cody, but his nickname came from the great numbers of buffalo (bison) he is said to have killed. Cody is mainly remembered for his famous Wild West Show that he founded in 1883. This show featured his ability as a marksman as well as mock Indian fights. It was a huge success and he toured the United States and Europe.

Bug is the name that many people, especially in America, use for insects in general. But only a certain group of insects, which make up the order *Hemiptera,* are accurately called bugs. They include aphids, or greenflies, water boatmen and pond skaters, blood-sucking bedbugs, cochineal insects, and water bugs.

Many bugs are rather like beetles, but only the front halves of the wing cases are hard. The back halves are made of membrane, and are often colourless. The name 'hemiptera' comes from Greek words meaning 'half wing'. All bugs have sharp needle-like mouthparts that can pierce plants and skin, and suck up the sap or blood into the mouth. Bugs that feed on blood usually have flat bodies, with claws on their feet so that it is difficult for the host animals to shake them off. Pond skaters have long thin legs on which they



Above: An assassin bug attacking a bed bug. Both are pests.
Right: A typical bug's head. Note the piercing mouth parts and the sheath cover.
Below: Aphids clustered on leaves. Aphid is the scientific name for greenfly and blackfly. These small bugs feed on the sap of plants and cause a great deal of damage.

can move over the surface of the water. The legs of water boatmen are long and flattened, and the insects use them as oars for swimming.

Bugs do not go through an inactive pupal stage as they develop. They emerge from the egg resembling a small adult without wings. The insect *moults* (splits its shell and grows a new one) several times before it is fully grown, and the wings get larger at each moult.

Building construction Multi-storey blocks of flats and offices, often hundreds of feet high, are being built in cities throughout the world. They provide a striking contrast to the smaller two- or three-storey houses around them.

Most houses are built using a mixture of the traditional materials of bricks and mortar, stone, and timber. A typical brick house has a double-brick wall with a cavity in between for insulation. The floors are of concrete or of boards which rest on timber joists. The joists are supported by the walls. The roof is of slates or tiles on a timber framework. The walls take the whole weight of the building. Such houses cannot be built too high because the walls would have to be impossibly thick to support the weight.

Large, modern buildings, however, are built around a reinforced concrete or steel frame, which provides all the necessary support for them. The walls take no load at all, they merely hang on the frame. Their main function is to keep out the weather. They can therefore be made of light materials, such as glass, sheet aluminium, or stainless steel. This type of walling is called *curtain walling*.

The modern building site is a busy, noisy place, with men, machines, and materials in constant motion. Concrete mixers churn and pile-drivers hammer. Bulldozers and excavators bite into the soil and dump their loads into huge trucks. High above, the tall tower cranes swing to and fro across the building, moving concrete and materials into place.

All buildings, especially high ones, must be built on firm foundations or, like the leaning Tower of Pisa, they will gradually sink into the ground, or even collapse. The kind of foundations chosen depends on the kind of soil on the building site. Engineers bore holes to discover what kind of soil is present.

If there is firm soil or rock near the surface, excavators and bulldozers remove the earth above it. And the concrete foundations can then be laid on a firm base. If firm soil lies a long way down, concrete piles must be sunk down to it. The building is then built on the piles.

When the foundations have set, work begins on the upper part, or *superstructure* of the building. The first job is to build the frame that will support it. The frame may be made by bolting together steel girders or precast reinforced concrete beams, or it may consist of reinforced concrete cast in position in wooden *shuttering*, or moulds.

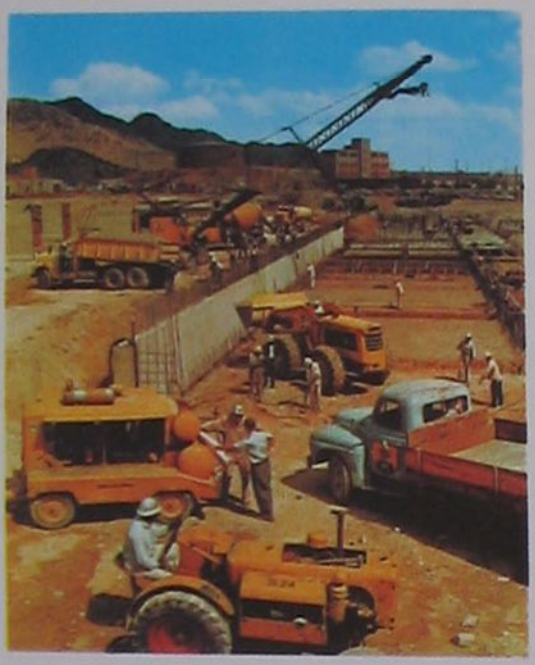
As each part of the frame is completed, workmen move in to continue the construction process. They erect a metal framework called *scaffolding* around the rising building so that they can move around it freely. Power lifts and hoists carry men and materials up to the various levels. By the time the whole frame has been erected, all stages of construction are proceeding in the building.

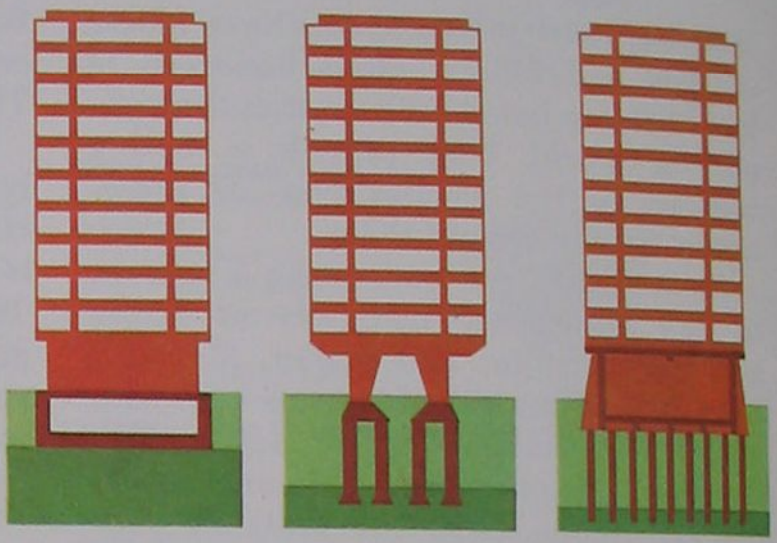
In the top storeys, the floors are being cast. A little below, work begins on the interior walls, and electricity and water services are installed. Further down, the curtain walls are raised and glazed. The interior walls are plastered, and final partitions erected.

Buildings can be erected more quickly by the lift-slab and jackblock methods of construction. In the *lift-slab* method, all the floors are cast at ground level and jacked up into position on supporting columns.

In the *jackblock* method, first the roof and then each floor are built on a central core of concrete blocks at ground level

Left: If there is firm soil near the surface, the first stage of building construction is to remove the upper layers of earth. This machine can quickly shift large amounts of earth with its powerful shovel. It also has a scoop for digging ditches for such things as drainage pipes.



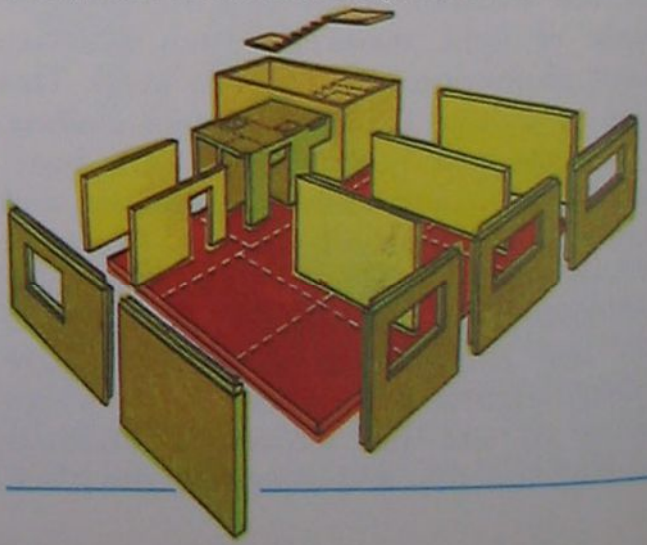


Left: Laying down concrete foundations on a large building site.

Below left: Cranes of several kinds are used in the construction of buildings. The mobile track-laying crane shown here carries a skip for transporting wet concrete.

Above: The foundations chosen to support high buildings depend on the strength of the underlying soil. On clay, a hollow concrete raft may be used to spread the load evenly (left). Or concrete piles may be sunk to firmer soil (centre). In soft soil many piles may have to be used (right).

Below right: The panel method is much faster than normal building methods. Each part of the building is factory-made and then fitted together on the site.



and jacked upwards little by little. The building is finished off from the top downwards as it is jacked up. This is the reverse of the normal process.

Some buildings are constructed quickly out of a number of ready-built units, or *panels*, cast in a factory. The panels are made to fit together exactly, with holes for windows, doors and water pipes. At the building site the panels are lifted into position and cemented together.

Talking points

* What materials were used in building your school?
* List the different trades of the men who helped build your home. Remember plasterers and plumbers, scaffolders and surveyors.
* Find out about building methods in different parts of the world and why such methods developed. You should consider local building materials, climate, and the kind of society.
* Make a list of what you consider to be the finest buildings in the world and give reasons for your choice.
* How have modern materials, methods, and machinery speeded up building?

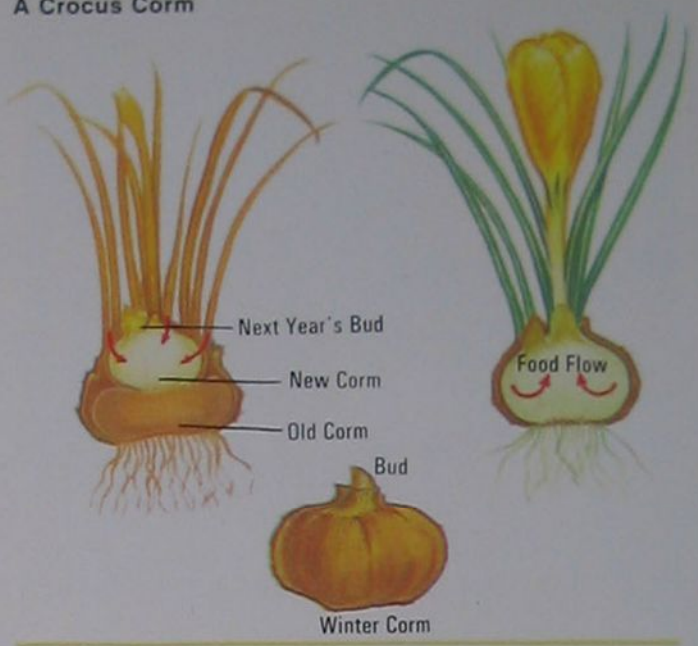
Articles to read

Architecture; Bricks; Bridges; Castles; Surveying.

Bulbs and corms are underground storage organs and a means of vegetative reproduction in plants. Bulbs and corms are very similar in outward appearance, and people often confuse them. The essential difference is that bulbs consist of special scales or leaves, swollen and packed with food reserves, whereas corms are the bases of stems, similarly swollen. By cutting a bulb or corm down the centre, you can tell which is which. One of the commonest examples of a bulb is the onion. It has thin, papery brown scale leaves on the outside. Within these are the layers of juicy, greenish-white leaf bases lying one inside the other. At the bottom of the bulb is the small, flat, white stem. Crammed between the leaf bases, and attached to the stem, lie axillary buds. These will form new bulbs next year. Apart from onions, other examples of plants that set bulbs include tulips, daffodils and lilies.

Corms are produced by crocuses and gladioli, and many other popular garden plants. During the growing season the base of the shoot swells with food. When the upper part of the shoot dies, a new bud takes its place and forms the following year's shoot. New roots grow from the base of the corm. The roots contract, pulling the new corm down into the soil. Each year the shoot and roots grow at the expense of the old corm which withers away to a shrivelled mass.

A Crocus Corm

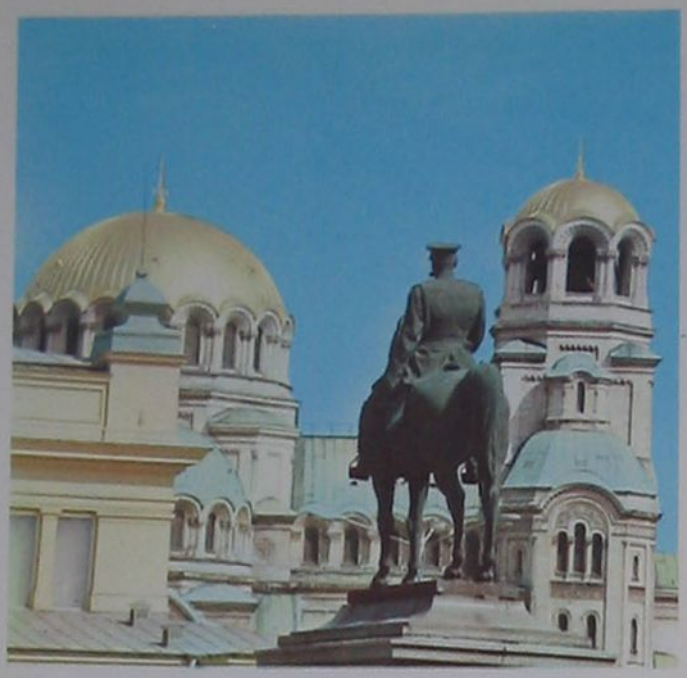


A Tulip Bulb

The plant makes food in the summer and stores it through the winter. The new plant uses the food to grow in the spring.

Bulgaria is a communist country in south-eastern Europe. It is part of the Balkan peninsula, and lies on the Black Sea.

The Balkan Mountains extend across the country from east to west. The Rila plateau and the Pirin and Rhodope mountains lie in the south-west. The Danube River flows along most of the northern



Facts and Figures
Area: 42,729 square miles.
Population: 8,500,000.
Capital: Sofia.
Above: The Alexander Nevski Cathedral in Sofia.
Below: A Bulgarian woman wearing peasant's costume.
Left: Bulgaria's coastline is on the Black Sea. The country is becoming increasingly popular as a holiday resort.

boundary with Rumania. The Maritsa River flows between the Balkan and Rhodope mountains. Southern Bulgaria has a mild climate, but the north has cold winters.

Bulgarians are a mixture of Slavs and Bulgars. Most of them belong to the Eastern Orthodox Church. But about a tenth of the people are Muslims.

Most Bulgarians live in small villages and more than half of them are farmers. They grow tobacco, cotton and fruit in the south. Roses are gathered to make perfume, and silk is made from silkworms which feed on mulberry trees. Bulgarians mine coal and other minerals and manufacture machinery. Dams provide hydro-electric power for industry.

Bulgaria became independent in 1878. Communists took control in 1944 and a Russian-type constitution was introduced in 1947. In the 1950's and 1960's, Bulgarians introduced many large industrial projects.

Bunyan, John (1628-1688), was an English author and preacher. His greatest book, *The Pilgrim's Progress,* is one of the masterpieces of English literature.

A *nonconformist* (a person outside the established Church), Bunyan persisted in preaching without a licence, and in 1660 was imprisoned for this offence. During his 12 years in prison he wrote *Grace Abounding* (1666), a book describing his religious experiences. After his release he became a *pastor* (minister in charge) of his church. In 1675 he was again imprisoned, this time for six months.

During this period, Bunyan wrote the first part of *The Pilgrim's Progress.* Written in simple, strong, Biblical style, the book is an *allegory* (a story invented to teach certain truths). It tells of the journey of a man called Christian from the City of Destruction to the Celestial City, through such places as the Slough of Despond and Vanity Fair. The journey represents the struggle of a Christian person to find God. Part two, published in 1684, deals with the travels of his wife Christiana, as she faces similar trials on her way to join her husband.

Burke and Wills. Robert O'Hara Burke and William John Wills were leaders of the first successful expedition to cross the

The Burke and Wills expedition leaves Melbourne. Wills, mounted on the left, is holding a surveying instrument, and Burke is leading two horses.

continent of Australia from south to north. But poor planning meant that the expedition ended in disaster. Burke, Wills, and another man died of starvation on the way back. Wills kept a diary of the trip, which was found beside his body.

The expedition of 18 men was sponsored by the Royal Society of Victoria, which provided camels from India and plenty of supplies. Burke, a former policeman from Ireland, was chosen to head the group, and Wills, an English-born surveyor and astronomer, later became his co-leader.

The group left Melbourne in August 1860, reaching Menindee in September. From there, Burke and a small group left for Cooper's Creek, about halfway to their destination. Instead of waiting for the others, Burke became impatient. Finally, he set off with Wills and two other companions, leaving instructions for the others to wait three months for their return.

In February 1861, having survived the rigours of desert, swamp and jungle conditions, they reached their objective at the mouth of the Flinders river near the Gulf of Carpentaria.

Despite low supplies of food, three of them managed to return to camp in April. But the camp party had left the same morning after waiting some months longer than arranged. From then on the two groups failed to make contact, and eventually Burke and Wills weakened and died. The lone survivor was cared for by friendly Aborigines and later rescued.

Burma is a country in south-eastern Asia. Surrounded by Bangla-Desh, India, China, Laos and Thailand, Burma is largely mountainous. Low hills and fertile plains extend to the Bay of Bengal.

The climate varies in Burma. The moun-

tainous areas are cool with an average annual rainfall of 40 inches. The hot foothills and plains receive an average rainfall of up to 200 inches.

The Irrawaddy River and its tributaries flow into the Bay of Bengal. The fertile plain, irrigated by the rivers, is ideal for rice growing. Rice is Burma's main export. Burma's dense forests provide the world's largest source of teak, another important export.

More than three-quarters of Burma's people are farmers who live in small villages. Buddhism, introduced into Burma more than 2,000 years ago, is the main religion.

From the A.D. 1200's until the 1800's, Burma was divided into small kingdoms. Attempts were made to unite the country by different leaders. During the 1800's Britain gradually took over Burma. In 1886, Burma became a province of India. In 1937, it was made a separate colony.

Japanese armies occupied Burma between 1941-45. In 1948, Burma became an independent republic outside the British Commonwealth. Many rebellions weakened Burma. In the 1960's, General Ne Win established a strong government based on socialist policies.

Burma is a thinly populated country twice the size of the British Isles.

Facts and Figures
Area: 261,789 square miles
Population: 27,600,000.
Capital: Rangoon.

Burundi is a country situated on the east side of Lake Tanganyika in central Africa. Its capital is Bujumbura. Burundi covers an area of 10,747 square miles and has a population of 3,600,000.

Most of the people are farmers, and

The marble tiled concourse of Schwedagon Pagoda, Rangoon, Burma.

Bush fires like this are greatly feared in the Australian outback and forest areas of New Zealand. Patrols with helicopters keep a sharp look out for them.

coffee is the chief export. Cotton is also grown and large herds of cattle are reared.

A former Belgian colony, Burundi was proclaimed an independent monarchy in 1962. In 1966, Burundi declared itself a republic.

This map shows the location of Burundi.

Buses are large motor vehicles used for public transport. They generally seat 30 to 50 passengers, and are used both for local travel within a city and for long-distance journeys. On short routes, double-decker buses are often used. Long-distance buses are usually roomier and more comfortable, and may even have washrooms. In country areas, buses are sometimes used to take children to school.

The first bus service was operated briefly in Paris by Blaise Pascal from 1662. It used horsedrawn vehicles seating six people. Buses were not used again until the 1800's, when services began in New York, London, Paris and Bordeaux. Steam engines were tried for a while in the late 1800's, but by the early 1900's petrol-driven engines had become customary. Today, many buses have diesel engines. Trolley-buses, now little used, run on electric power drawn from overhead lines.

Bush fires are dangerous and destructive fires that break out in such areas as the Australian outback. They occur during periods of severe drought when trees and shrubs become as dry as matchwood. Strong winds often fan such fires and sweep them across hundreds of miles of territory. When populated areas are threatened, the people must be evacuated. In recent years, bush fire disasters in

Tasmania, New South Wales and Victoria have resulted in the loss of human lives and much damage to property.

Bush fires are spotted by observers in aircraft. Volunteers then try to beat out the flames. But if a blaze is extensive, fire fighters dig wide trenches, over which the flames have difficulty in leaping, or isolate the fire by clearing a large area round it.

Bushrangers were the outlaws of the Australian frontier of the 1800's. Gangs of them would roam the countryside holding up isolated farms, stealing cattle and horses, and robbing banks, mail coaches and shipments of gold. Their exploits became legendary in stories and songs.

The early bushrangers, such as Matthew Brandy and John Caesar, were mostly fugitive convicts. Bushranging increased after gold was discovered in 1851. It reached its height in New South Wales and Victoria from about 1860 to 1880, during a period of land disputes, unfair laws and general corruption. There, the gangs of Ben Hall, Frank Gardiner and Ned Kelly, the armoured bandit, made their famous raids. In the end, all the bushrangers were captured or killed.

Bute, a county at the entrance to the Firth of Clyde in south-western Scotland, is made up of seven islands. They are Bute, Arran, Great Cumbrae, Little Cumbrae, Holy Isle, Inchmarnock, and Pladda. Its county town is Rothesay, and its area is 218 square miles.

The islands are mainly rugged and are often stormbound in winter. Tourism and agriculture are the main industries. Bute's nearness to Glasgow makes it a popular holiday resort for Scots. The Kyles of Bute, a narrow channel separating Bute from the mainland, is noted for its scenic beauty.

Butter is a rich food made from the cream of milk. It is usually eaten as a spread on bread, but cooks may use butter for frying and for making cakes and pastries. Butter consists of about four-fifths fat, the remainder being water, salt and protein. Butter in fact consists of the fat in the cream, and it is made by separating the fat from the rest of the cream by churning it. For many centuries, farmers have made butter from cream by churning it by hand in a wooden vat. Nowadays butter is made by machines in a continuous process.

First, the milk is whirled in a centrifuge to separate the cream. The cream is then pasteurized by heating it and then cooling it quickly. This action kills germs in the cream, and prevents the butter from going rancid quickly. The pasteurized cream is then churned in huge revolving drums. The fat separates from the liquid in the cream, called *buttermilk*, which is drained away. The resulting mass of butter is then cut into pieces and packed.

Butterflies are the most beautiful of insects. Like moths, butterflies have large wings, often with brilliant colours and

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The butterflies on the facing page are two-thirds actual size.

1. Ulysses' Butterfly *(Papilio ulysses)*
   Australia, New Guinea.
2. The Monarch or Milkweed *(Danaus plexippus)*
   North and South America, Australia, New Zealand, Britain, and the Pacific Islands.
3. The Brimstone *(Gonepteryx rhamni)*
   The original butter (coloured) fly
   Europe (including Britain)
4. The Small Copper or American Copper *(Lycaena phlaeas)*
   Europe (including Britain) and North America
5. The Zebra *(Heliconius charithonia)*
   North and Central America.
6. The Fiery Acrea *(Acraea acrita)*
   Africa.
7. The Zebra Swallowtail *(Eurytides marcellus)*
   North America.
8. The Smokey Orange Tip *(Colotis evippe)*
   Africa.
9. The Camberwell Beauty, or Mourning Cloak *(Nymphalis antiopa)*
   Europe (including Britain) and North America.
10. The Regent Skipper *(Euschemon rafflesia)*
    Australia.
11. Kahukura or Rainbow Butterfly *(Pyraemis gonerilla)*
    New Zealand.
12. The Adonis Blue *(Lysandra bellargus)*
    Europe (including Britain).
13. The Silver Barred Charaxes *(Charaxes druceanus)*
    Africa.
14. The Birdwing *(Ornithoptera priamus)*
    Australia, New Guinea.

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striking patterns. The wings are covered with minute scales. If you handle a butterfly or a moth, a certain amount of 'dust' comes off the wings. The dust is, in fact, thousands of these scales. Zoologists classify butterflies and moths in the order *Lepidoptera*, which comes from Greek words meaning 'scaly wings'.

It is not always easy to tell butterflies and moths apart. As a general rule, moths fly at night and butterflies during the day. Also, a butterfly usually holds its wings upright when it alights on a plant, whereas a moth usually spreads its wings out flat.

Butterflies are born from eggs. They emerge into the world as small worm-like creatures called caterpillars, which have eight pairs of legs. Caterpillars eat leaves and other parts of plants, sometimes causing serious damage to crops. As they grow, they shed their skins and grow new ones several times. When a caterpillar reaches its full size, it *pupates* —it splits away its skin and a hard shell forms over its body. The pupa does not eat and hardly moves. But inside the adult butterfly is forming. Eventually, after a period of from two weeks or so up to several months, the shell cracks and the butterfly emerges. It hangs with its soft wings downwards, and pumps air and blood through its body. The body and wings expand to their full size, and the body's *exoskeleton* (a hard shell supporting the body) hardens. In half an hour, the butterfly can fly away.

Butterflies emerge from pupae in warm weather. They fly about, feeding on nectar from flowers. The mouth parts are very flexible, and reach right down into a flower. They form a *proboscis* through which a butterfly sucks up the nectar. When it has eaten, the proboscis coils up under the head. To straighten its proboscis, the butterfly pumps blood into it so that it uncurls. As the butterfly flies about, it carries pollen from one flower to another and helps the flowers to produce fruit and seeds.

Most adult butterflies die when winter comes, leaving the young stages to continue the species the following year. Some adult butterflies, however, hibernate through the winter. Others migrate to warmer parts. They may fly great distances, sometimes in great swarms. Painted ladies, for example, migrate between North Africa and Iceland, a distance of 2,000 miles.

There are many thousands of different butterflies. The largest have a wingspan of nearly a foot, the smallest about half an inch. Many have brown-yellow patterns to hide them among plants from hungry predators, and some even have eye-spots. These spots resemble eyes, and scare away attackers. Many butterflies of South America are spectacular. The morpho butterflies have huge wings of iridescent blues and greens.

In highly cultivated areas, butterflies have become rare. They are being killed off by insecticides, and they should not be captured.

Byzantine Empire was founded by the Emperor Constantine the Great in A.D. 330, when he moved the capital of the Roman Empire from Rome to Byzantium, a city in Asia Minor. He rebuilt the city and named it Constantinople. Today it is called Istanbul. In 395, after the death of the Emperor Theodosius I, the Empire was divided into the Western Roman Empire (with Rome as its capital) and the Eastern Roman Empire or Byzantine Empire (with Constantinople as its capital).

As the Western Empire declined and eventually fell to barbarian invaders, the Byzantine Empire grew in importance. It remained in existence for nearly 1,100 years, bringing together and preserving the traditions of ancient Greece and Rome, of Asia, and of the Christian Church. At the height of its power its territory included most of the lands around the Mediterranean Sea, and extended north to the Black Sea.

The Golden Age of the Byzantine Empire was from 527 to 565, during the reign

The Byzantine Empire produced many magnificent works of religious art, particularly in mosaic. This 11th-century mosaic shows the three Holy Children in the fiery furnace.

of the Emperor Justinian I. He won back important territory that had been lost in the west, and repelled the Persians in the east. During this period, many of the splendid churches, colourful mosaics and ornate icons that characterize Byzantine art were created. Roman law was codified, and Greek literature revived.

After Justianian's death, the Empire began gradually to decline. His successors lost much territory, and by the 800's only Asia Minor and Greece remained.

However, the power of the Empire increased again during the next few centuries. Through the Eastern Orthodox Church, its influence spread to Russia. Science, philosophy and commerce flourished. But there was ill-feeling between the Catholic Christians of the West and the Orthodox Christians of the East.

In the late 1000's, the Byzantine Empire started to decline again. Its territories, constantly under attack by the Turks, were invaded also by the Crusaders, who held Constantinople for more than 50 years.

In 1453, Constantinople fell finally to the Turks, and the Byzantine Empire came to an end.

When Constantinople, capital of the Byzantine Empire, fell to the Turks in 1453, many of the learned men who had lived there fled to other cities in western Europe, often taking with them classical manuscripts. So they helped arouse an interest in the learning of ancient Greek throughout Europe. The date of 1453 is widely thought of as the end of the Middle Ages and the beginning of the Renaissance, a word meaning 'rebirth' of interest in ancient learning.

C

Cables The most reliable way of sending messages around the world is by cable. Cables carrying telegraph and telephone messages form a permanent link between continents. Radio is not a very reliable means of communication, because atmospheric conditions can interfere with reception.

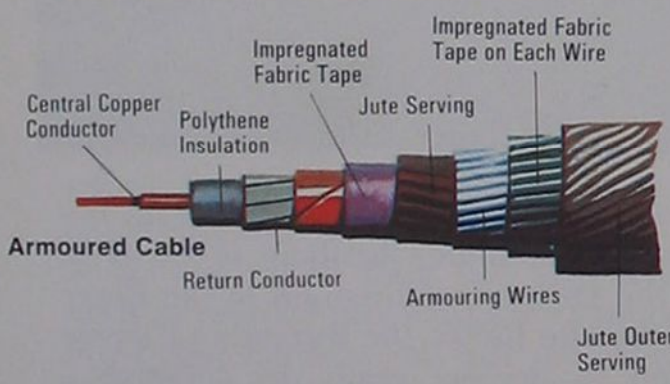
The first successful submarine cable was laid across the Atlantic in 1866. Cyrus W. Field, an American businessman, hired the largest ship then afloat, the *Great Eastern,* for the operation.

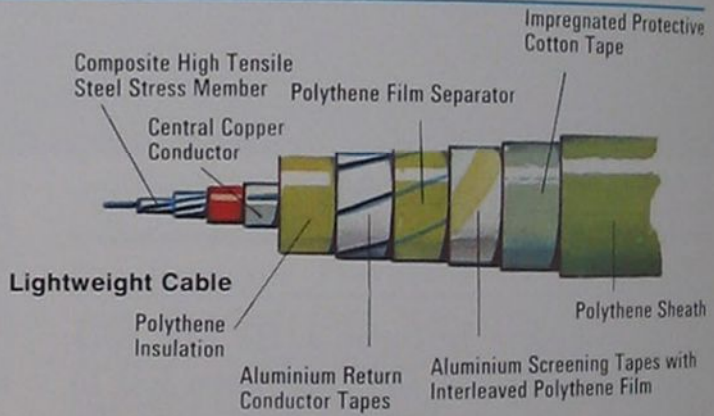
Cable-laying today is done by special cable ships, which have the cable stowed in huge tanks. It takes weeks just to load the tanks, which may hold 2,500 miles of cable. When the ship begins laying, it pays out the cable through a cleft in its rear. The cable is lowered until it rests on the ocean bed.

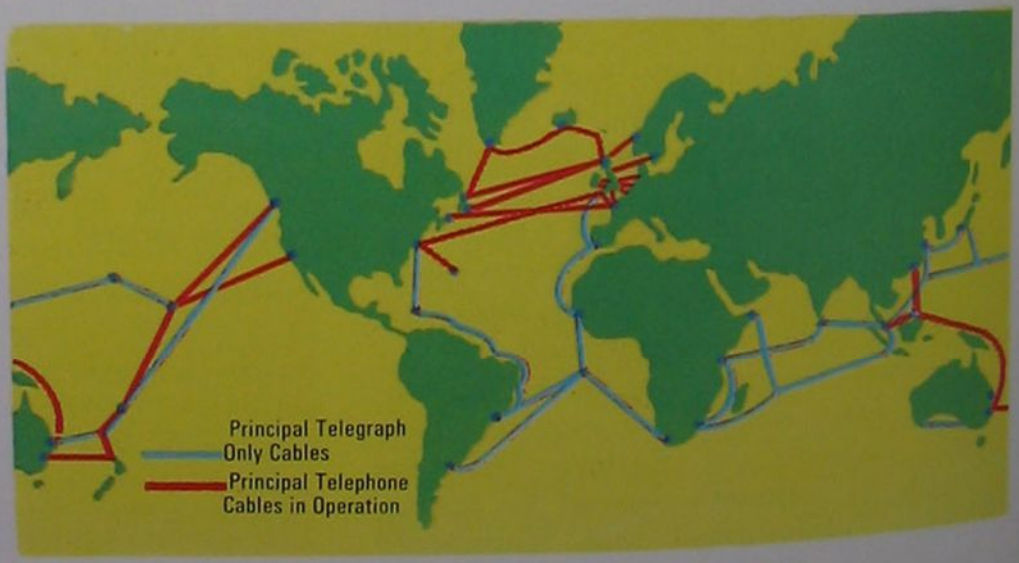
At intervals along the cable are *repeaters,* which are devices to amplify (strengthen) the signals passing through the cable. The cables now being laid can carry up to 720 separate telephone conversations at the same time.

The cable itself consists of one or more *coaxial* cables. Such a cable has a copper tube with a wire core. The whole thing is heavily insulated, and strengthened with steel wires to prevent it breaking.

Telegraph and telephone cables are laid underground, too. They are replacing overhead wires. They are generally bigger and can carry more messages than underwater cables. Low-voltage electric *power cables* are laid underground from distributing sub-stations to our homes. They are heavily insulated and sheathed in lead and steel for protection against corrosion and other types of damage.







Principal telephone and telegraph cables of the world.

Cacti are flowering plants that have become adapted to life in hot deserts. Since the major drawback to life in the desert is lack of water, most adaptations of cacti are for efficient water absorption and conservation. Thus, most cacti have huge spreading root systems which cover enormous areas of soil close to the surface. Such systems pick up a great deal of the infrequent rainfall before it evaporates.

Cacti, like most plants, consist of 90 per cent water. At the same time, they are extraordinarily efficient in keeping what water they have. They are compact in shape—barrel shaped, spherical, globular, or tubular—and this keeps their surface area relatively small compared with their volume. A reduced surface area cuts down the amount of water lost to the atmosphere. Other factors which cut down water loss are a thick outer covering, and reduced leaves.

Cactus leaves are reduced and modified into protective prickles called *spines*. The food-making job that is the responsibility of the leaves in all normal plants is taken over in cacti by the green stems. The stems possess only a very few *stomata* (pores) in their surface, so again, water loss is kept to a minimum. The most important modification of all is water storage tissue in the stems. The cells absorb and hold water strongly, and the fat, fleshy stems can expand enormously when water is freely available.

Cacti are perennial plants. Most of them live in the deserts of south-western North America.

The structure of a typical cactus. Notice the vast horizontal spread of its fibrous root system.

There are over a hundred different kinds of cactus, and four of the most common are illustrated below:
1. Echinocactus, 2. Echinocereus, 3. Mammilaria, 4. Trichocereus.

Caernarvonshire is a mountainous county in north-western Wales. Its county town is Caernarvon, and its area is 569 square miles.

To the west, Caernarvonshire is linked with the island of Anglesey by the Menai bridge across the Menai Straits. In the east is a mountain range whose highest peak is Snowdon (3,560 ft). Farther east lies the magnificent Conway Valley. The

mountain region of Caernarvonshire, with part of the adjoining county of Merionethshire, make up the Snowdonia National Park. Caernarvon Castle, begun by Edward I in 1283, is one of the glories of Wales.

Cairo (pop. 3,400,000), the largest city in Africa, is the capital of Egypt. It stands on the right bank of the River Nile, at the head of the delta. Just across the Nile stand the pyramids of Giza. The Nile brings an immense amount of trade to Cairo, which is an important industrial and trading centre.

Mosques with *minarets* (towers) dominate all parts of the old quarter of Cairo. The mosque of Ahmed ibn-Tulun is the oldest and one of the finest examples of Muslim architecture. Built in the 9th century, its square building has a central dome and one minaret. Cairo has many museums and colleges and is the most important centre of learning in the Muslim world. The al-Azhar University, founded in the 10th century, attracts students from Muslim countries all over the world.

Caisson A structure called a *caisson* is used in bridge building, for example, to construct underwater foundations. It is usually square or circular in shape and made of concrete, steel, or both.

The simplest kind of caisson is the *box caisson*. This is simply a huge box which is floated out into position and then sunk. The *open caisson* is open at both ends. It is sunk on to the river bed, and material is dredged from around the lower, cutting edge. It sinks down under its own weight until it finally reaches firm rock.

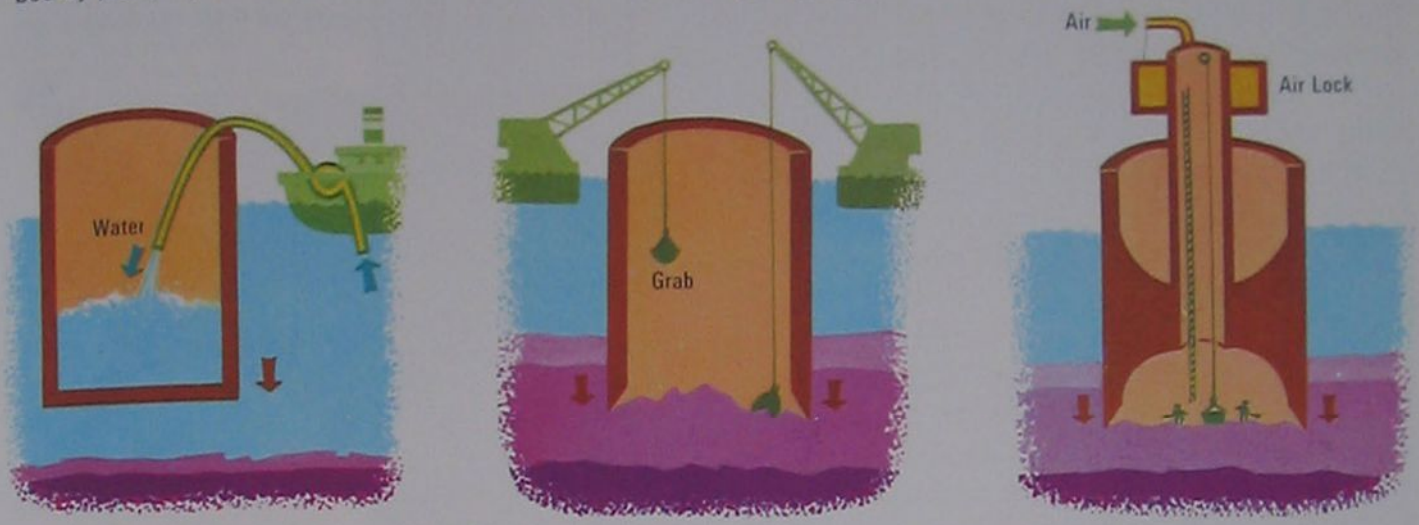
The *pneumatic caisson* also has a lower cutting edge, but it is designed so that workmen can excavate inside it on the river bed. Air under pressure is supplied to the working chamber to keep the water out. Workmen must pass through air locks to maintain the pressure.

Snowdon, the highest point in Wales, lies in Caernarvonshire. It is surrounded by the national park of Snowdonia, more than 800 square miles in area, which is a popular region with climbers.

The box caisson is towed into position and then sunk to the sea or river bed by pumping in water.

The open-ended caisson sinks under its own weight as grabs remove earth from the lower cutting edge.

The pneumatic caisson is supplied with compressed air so that workmen can excavate inside it.



Caithness, in the extreme north-east of Scotland, is the most northerly county of the British mainland. Its county town is Wick, and its area is 686 square miles.

Dunnet Head, the northern tip of Britain, lies some 12 miles west of John O' Groats, the traditional northernmost point. Most of the county is a bleak, windswept plateau. Some sheep and cattle are reared, and there is a short fishing season off the rugged coasts. Some sandstone is quarried. The largest town is Thurso. There is an atomic power station at Dounreay, about 8 miles away. In the Middle Ages, Caithness was controlled by vikings from Scandinavia.

Calcium (symbol Ca), a chemical element, is a soft, silvery metal in its pure state. It never occurs naturally in this form, but compounds of calcium are cheap and abundant. The most common of all is calcium carbonate, found in chalk, shells, limestone and marble. Humphry Davy, the English chemist, was the first to produce pure calcium, in 1808.

Calcium compounds go into a wide variety of useful products, such as cement and plaster, fertilizers, insecticides, bleaching powder and toothpaste.

Bones and teeth are largely calcium, and our bodies must have calcium for proper functioning of the heart. Therefore, foods containing calcium – milk, for example – are essential to our diet.

Calcutta is the capital of the state of West Bengal in north-eastern India. The city with its suburbs has a population of 7,040,300, which makes it one of the largest metropolitan areas in the world. The unusually rapid growth of Calcutta has made it one of the most overcrowded cities in the world.

Calcutta was the capital of British India from the end of the 18th century until 1911. It is now an important industrial and commercial city and the world's largest jute manufacturing centre. Calcutta is also an important cultural centre and a university city, with many fine buildings.

Calendar is a method of organizing time into days, months, and years. Early man realized that time can be measured in three natural units: the *solar day*, the *lunar month*, and the *solar year*. A solar day is the time taken for the Sun to cross the heavens as the Earth rotates. It is now divided into 24 hours. A lunar month is the time between full moons, and is

equal to 29½ days. The solar year is the time taken for the Earth to go once around the Sun, and is almost 365¼ days.

Early man did not have an easy way of finding out exactly when a year had passed, so he based his calendar on the lunar month. But, to predict the seasons accurately so as to know when to sow and harvest crops, it is necessary to have a calendar giving the solar year. As there are 12 lunar months and 11 days in a year, it is difficult to keep a lunar calendar right without making frequent and complicated adjustments to it. So early calendars soon got confused, and the seasons would come at different times of year according to the calendar.

The ancient Egyptians probably began a useful solar calendar, and the Romans invented the calendar that we use today. In 46 B.C., Julius Caesar decreed that the year be divided into twelve months, starting with January, each of 30 or 31 days except February, which had 29 days and 30 days every fourth year. The emperor Augustus later took a day from February and put it on to August, which he named after himself. The average length of the year with this calendar, the Julian calendar, was exactly 365¼ days. Later it was decided that there should be two eras, B.C. and A.D., meaning before or after the birth of Christ.

The Julian calendar worked well for over 1,500 years. But the calendar year was 11 minutes 14 seconds longer than the solar year, and by 1580, it was 10 days out. In 1582, Pope Gregory XIII decreed that 10 days be removed from the calendar, and made a small change in it: every 100 years, February will not have an extra day, except for the years 1600, 2000, 2400 and so on. The Gregorian calendar is the one we use today; it is accurate to 26·3 seconds per solar year.

California is a large state on the Pacific coast of the United States, famous for its varied scenery, including deserts, mountains, waterfalls, beaches, and forests of giant sequoia trees; its pleasant climate; its immense agricultural output; its Hollywood motion picture industry; and the outdoor life of its residents.

California's population of almost 20

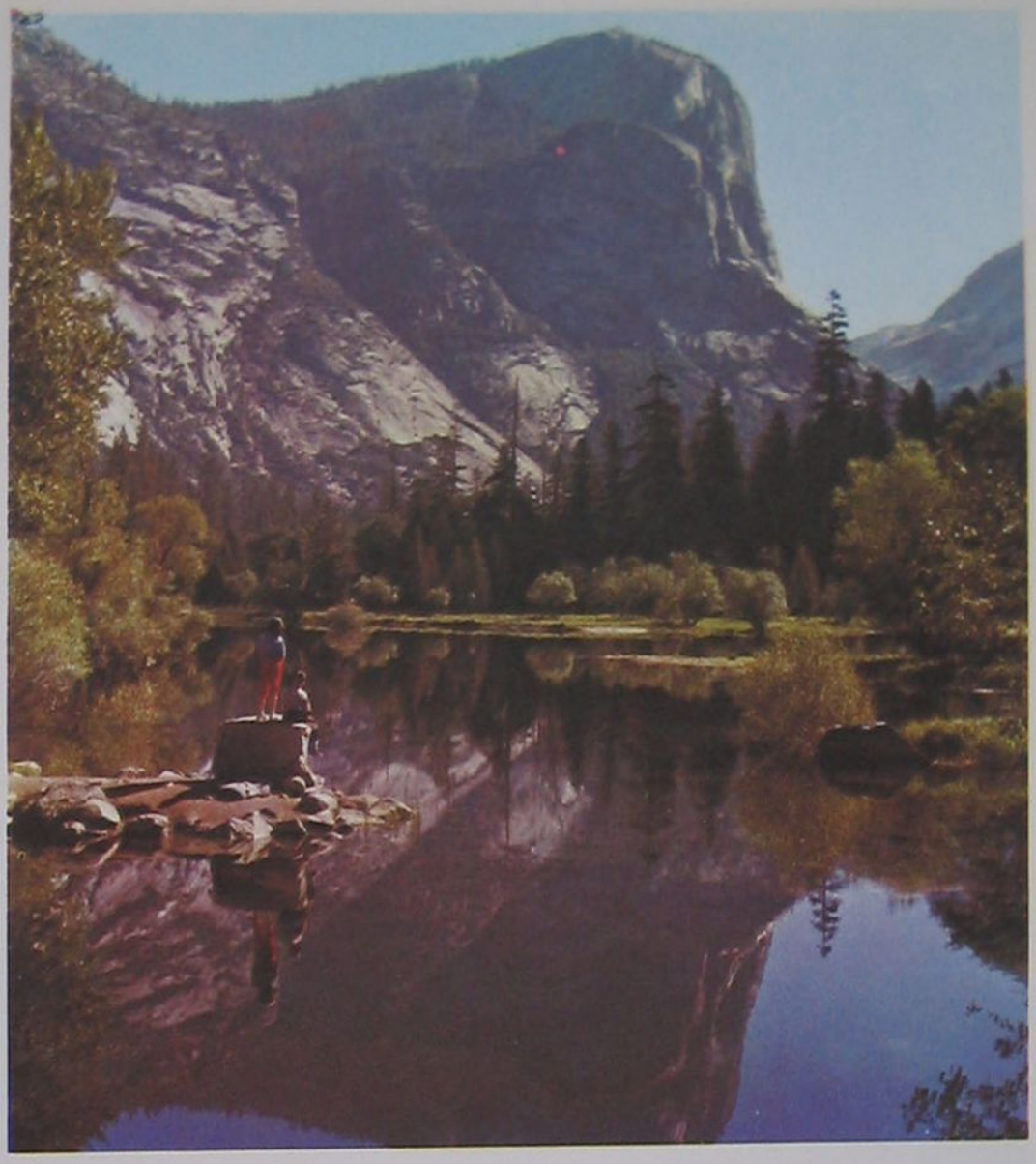
This location map shows the position of California.

million is higher than that of any other state, and is still growing. Millions of people live in its two great cities – sprawling Los Angeles in the south, well known for its miles of freeway and its smog; and picturesque, hilly San Francisco in the north, which is a university and cultural centre. Other large cities are San Diego and Sacramento, the capital.

California's Central Valley, situated between two mountain ranges, is the United States' most productive farming area, yielding citrus fruit, grapes, lettuce, nuts, sugar beets and many other kinds of fruit and vegetables, as well as cotton. Lumbering and fishing are also important.

California is second only to New York in industry. Factories produce electronic equipment and aircraft, and the state's processed food products include tinned fish, frozen fruit and vegetables, packed meat and wine. Petroleum, the state's most valuable mineral, comes from offshore drilling.

Spanish missionaries were the first Europeans to settle in California. The region was part of Mexico, but was ceded to the United States in 1848 after the Mexican War. The discovery of gold in 1849 brought thousands of prospectors, and California was made a state in the



Mirror Lake and Mount Watkins, in the Yosemite National Park in California. Yosemite National Park is one of 270 parklands that have been set aside by the U.S. government. In total they cover an area of about 46,000 square miles.

following year. After the completion of the transcontinental railway line in the 1860's it developed rapidly.

Calvin, John (1509-1564), was a French Protestant religious leader and reformer. He departed from Catholic teachings in 1533 and became one of the leaders of the *Reformation*—the religious movement that originally tried to reform the Catholic Church.

Calvin was expelled from Paris in 1534 because of his teachings. He eventually settled in Geneva, Switzerland.

Calvin's system of church government is known as *Presbyterianism*. His teachings, called *Calvinism*, were embodied in his book, *Institutes of the Christian Religion* (1536). He rejected the authority of the pope; maintained that faith was superior to good works; and taught that some people were *predestined* (their fate settled beforehand) to be saved, while others were damned.

Cambodia or the Khmer Republic is an independent country in southeastern Asia. It is bordered by Thailand to the west, Laos to the north and Vietnam to the east. The gulf of Thailand forms a coastline in the south. Cambodia is mainly a flat country and covers an area of 69,898 square miles. The capital is Phnom Penh in the southern part of the country.

Cambodia has a population of about 7,100,000 people, most of whom are farmers. Rice is the leading crop. Corn, sugar, and tobacco are also cultivated. Much of Cambodia is covered by dense tropical forest in which elephants and

Left: Gilded and painted statues in Cambodia's magnificent temple at Angkor.

Opposite: King's College Chapel, Cambridge, was founded by King Henry VI in the 15th century. In the foreground is the river Cam, which runs behind several of the colleges. King's College is world-famous for its choir.

buffalo are found. The forests provide rubber, charcoal and timber, which are exported. Fish is also a leading export.

Most of the people of Cambodia are followers of the Buddhist religion. From the 800's to the 1200's, Angkor in north-western Cambodia was the capital of a powerful Khmer Kingdom that achieved a rich Hindu-Buddhist civilization. Foreign wars and too much effort spent on building weakened and destroyed the Khmer Empire. The magnificence of Khmer building is shown by the vast ruins of the city of Angkor Thom and the temple of Angkor Wat.

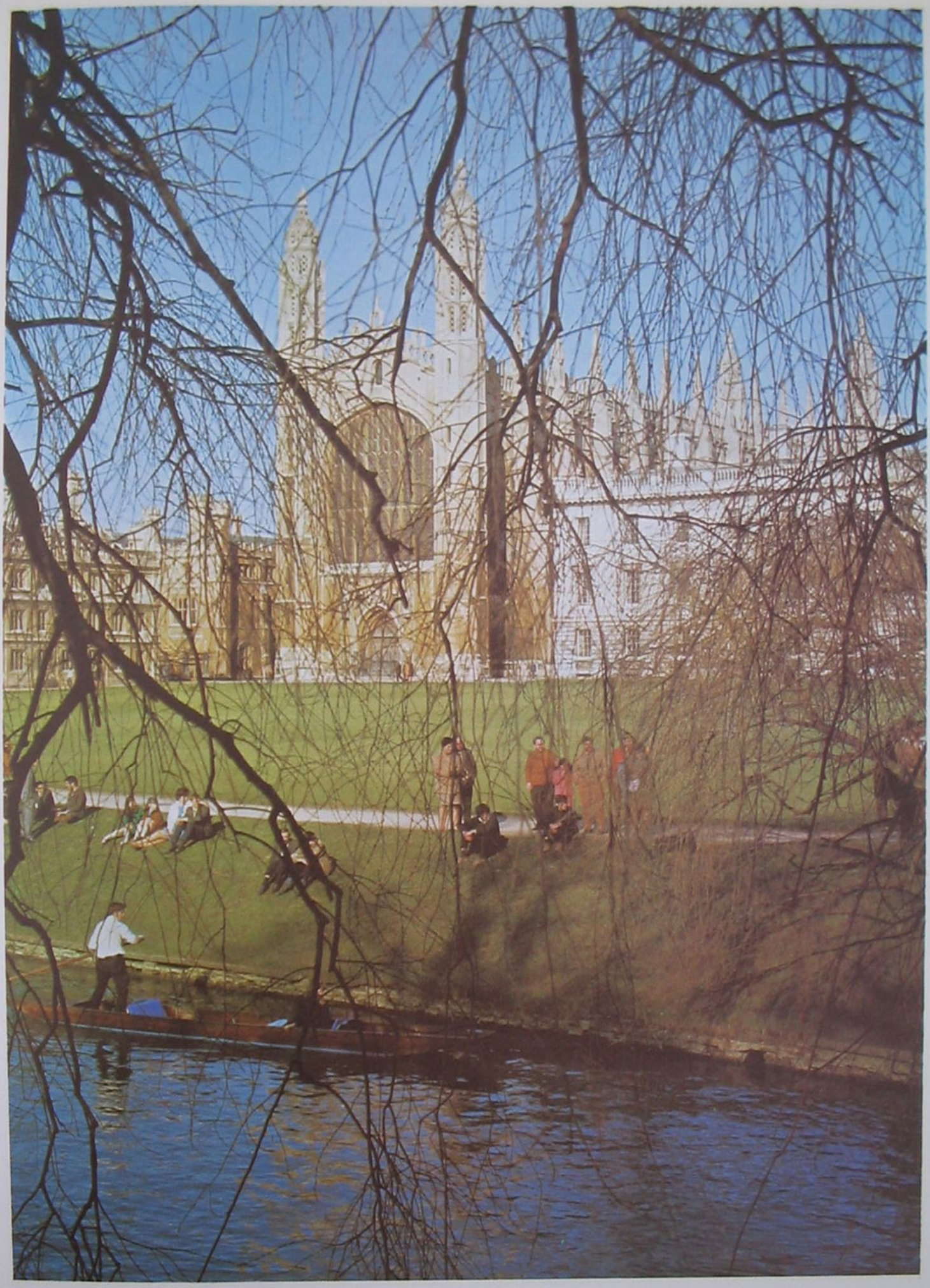
This map shows the location of Cambodia.

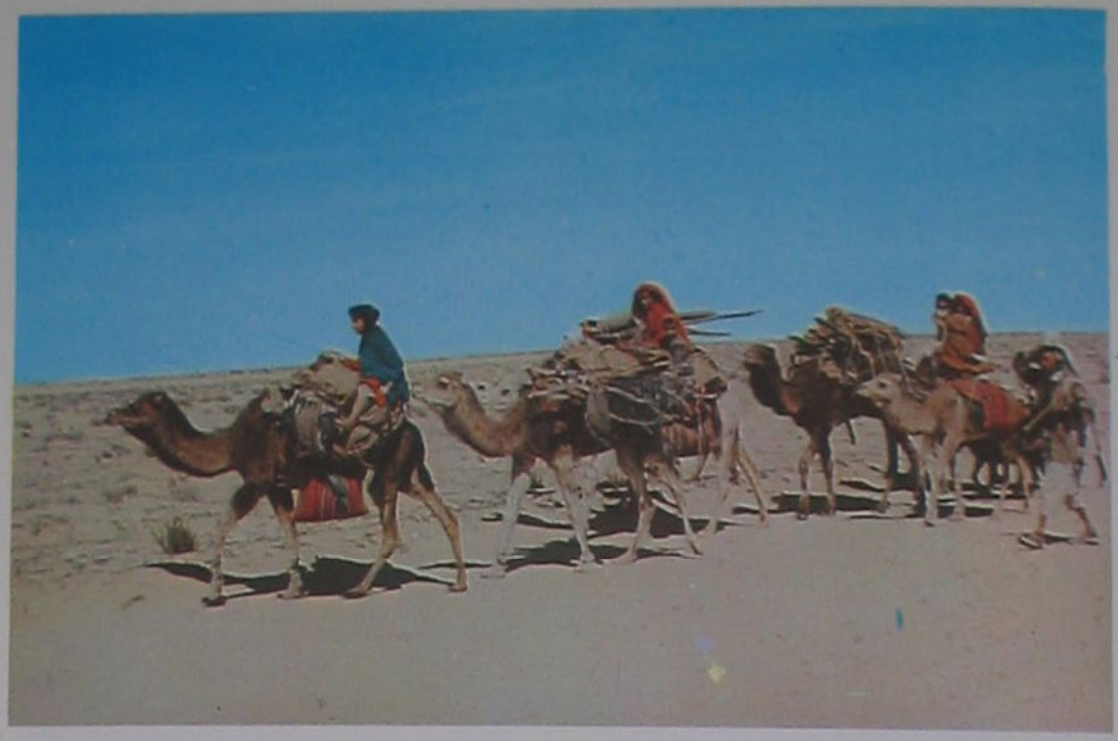
Annexed by France in 1863, Cambodia became independent again in 1955. During the 1960's, Cambodia, under its ruler Prince Sihanouk, tried to remain neutral in the war in neighbouring Vietnam. This proved increasingly difficult. In 1970, Sihanouk was deposed.

Cambridge is a city, municipal borough, and county town of Cambridgeshire, in eastern England. It stands on the River Cam, or Granta, 51 miles north of London. Its population is 98,519.

The city's main industries include the manufacture of scientific instruments, radio and electronics, flour milling, printing, and cement making.

Cambridge University, one of the oldest in Europe, was founded in the 1100's. The oldest college is Peterhouse, founded in 1284. Women were granted full membership of the university in 1948.





The camel most commonly used for riding is the one-humped dromedary, a special breed of Arabian camel. Their ability to store water, the food reserves in their humps, and their spreading padded toes make camels able to undertake long desert journeys.

The university buildings provide much of the city's beauty and dignity. The University Botanic Garden, and the Backs—the gardens and lawns that line the banks of the River Cam behind the main colleges, are notable.

Cambridgeshire, a mainly flat inland county in the east of England, includes the separate administrative county of the Isle of Ely. Its county town is Cambridge, and its area is 831 square miles.

Cambridgeshire lies mostly in the Fens, low-lying stretches of land that once formed a bay of the North Sea. The Fen country is now extensively criss-crossed with water courses and drainage canals. The soil is extremely fertile.

The county's only uplands are some hills to the south-east of Cambridge. The main rivers are the Ouse and the Nene.

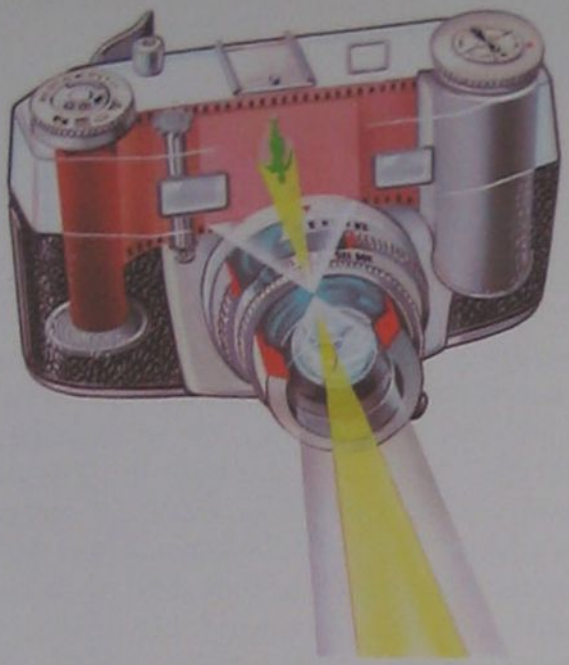
Agriculture is the chief occupation. Cereals, fruit and dairy foods are important, and there are some sheep farms. The chief towns are Cambridge, Wisbech, March and Ely.

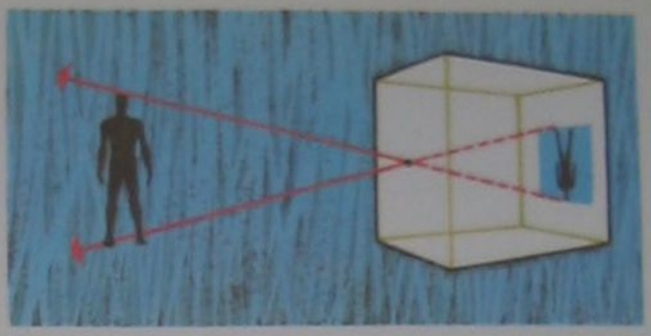
Camels are the hump-backed beasts of burden of the African and Asian deserts. Few, if any, wild camels exist. Most are either domesticated or descended from domesticated animals. Man has used them for thousands of years to carry himself and his goods over great distances. The secret of the camel's great ability to travel long distances without food is its hump, which is a fat-storage organ. It can survive on this fat for a long time, needing only occasional water. This, too, it can store to a certain extent in its stomach.

There are two species of camels. The most common is the single-humped *Arabian camel* of northern Africa and south-western Asia. The *dromedary* is a long-legged, fast-running variety of this species. The second kind of camel is the double-humped *bactrian camel.* It lives in the cold deserts of central Asia.

Camera The camera with which we take photographs is basically a very simple instrument. Light rays from the object we are photographing enter a light-tight box through a small hole at one end. They form an image of the object on a strip of light sensitive material called a *film* at the other end. But the image is invisible until the film has been treated with chemicals, or *developed.* (See Photography.)

The simplest camera is the *pin-hole* camera, which has a tiny pin-hole to let





Above: A simple pin-hole camera produces a sharp image only if the hole is very small.

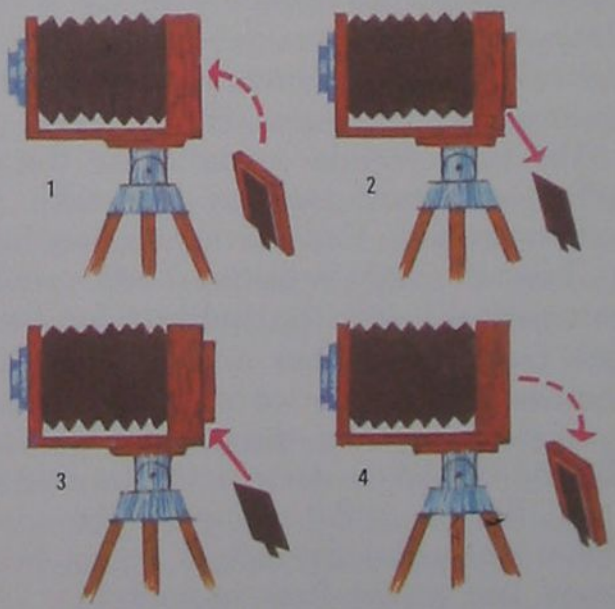
Left: Rays of light are shown passing through the lens forming an image on the film at the back of the camera.

the light through. The hole has to be small to form a sharp image.

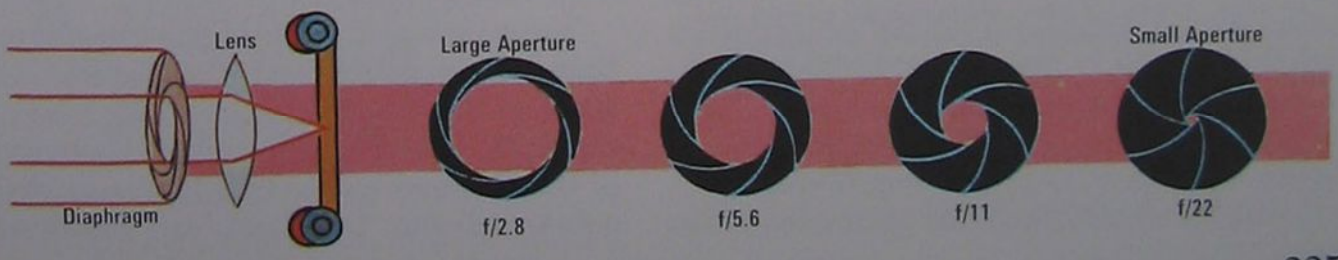
The *box* camera has a bigger opening, or *aperture*, with a lens in it which *focuses*, or makes sharp, the image. A shield, or *shutter*, covers the aperture when the camera is not in use. To take a picture, we press a button to open the shutter for a fraction of a second to let in the light rays.

One drawback of the box camera is that there is no control over the light passing through the lens. The aperture cannot be opened wider to let more light through on a dull day, or made smaller to let less light through on a very bright day. As a result the photograph taken may often be too dull or too bright. Another drawback is that the lens cannot be adjusted to focus on both near and far objects, and sometimes the image is blurred. The image is also blurred by movement of the object while the photograph is being

Below: Using a plate camera. Before the film is inserted the photographer focuses the image on the ground glass screen. The film is put in its holder (1). The dark slide is removed (2) and the shutter opened. The dark slide is then replaced (3) and the film holder removed (4).



The diaphragm of a camera can be adjusted to alter the size of the aperture. A large aperture is used on a dull day and a small one on a bright day.



taken. The shutter speed of the simple camera (about one-thirtieth of a second) is too slow to stop movement.

These drawbacks are overcome in better cameras by having adjustable controls to alter the aperture, the focusing of the lens, and the shutter speed.

The size of the lens aperture is controlled by an iris diaphragm – a metal disc with a central hole which can be altered in size. The sizes of the aperture are denoted by *f*-numbers, which may run from 22 (small aperture) to 2.8 (large).

Focusing is done by moving the lens in for far objects and out for close objects. Most cameras can be focused from about three feet upwards. Shutter speeds on most cameras range from one-thirtieth to one-five-hundredth of a second, which will stop the movement of splashing water.

Cameras generally have a special setting which keeps the shutter open all the time the release button is pressed down. Also, most cameras are designed for use with a *flash-gun*, which provides bright artificial light in dim conditions. Pressing the shutter release triggers off the flash.

The most popular cameras are the so-called *miniature* cameras that take 35-millimetre film. Expensive ones may have a built-in light-sensitive cell, which automatically sets the aperture for every light condition. They may also have a built-in range-finder to simplify focusing.

In many cameras, the picture we see in the viewfinder is not exactly the one we take. But in *reflex* cameras, the viewfinder shows us the actual image being taken, and we can focus accurately.

Cine cameras are essentially the same as still cameras. They merely take a series of 'stills' in quick succession.

Talking points

* List some 'do's and don'ts' for taking a good photograph, and their reasons. For instance, why avoid taking someone's face against a background of trees?

*Make your own pinhole camera.

*Do you think a coloured photograph can take the place of a realistic painting to decorate a room? And has photography altered the way in which artists work?

Articles to read

Cinema; Light; Microfilm; Newspapers; Paintings; Television.

This map shows the location of Cameroon.

Cameroon is a mountainous country in western Africa covering an area of 183,569 square miles. Its population is 5,800,000 and its capital is Yaoundé. Cameroon is mainly a farming country. It is one of the world's leading producers of cocoa. Minerals, such as gold, diamonds, bauxite and tin, are mined. Cameroon was German from 1884 until 1919 when Britain and France took it and divided it. Part of the British Cameroon united with French Cameroon in 1961 to form an independent country.

Camouflage Every living creature is engaged in a 'struggle for survival'. In order to live, it preys on other creatures or on plants for food. It, in turn, is hunted by others. If an animal is difficult for its predators (those that hunt it) to see, then it stands a much greater chance of survival. Camouflage is one way this happens: the animal closely resembles its surroundings.

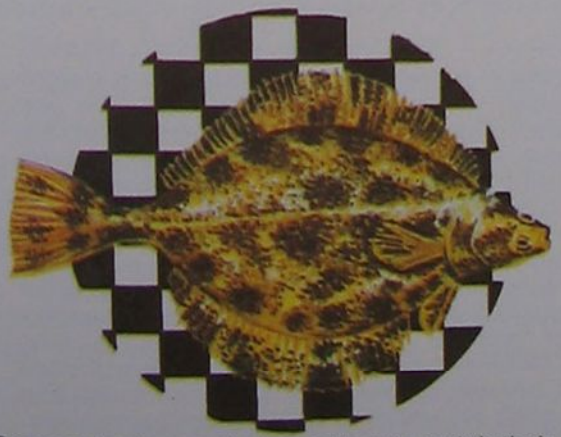
Some of the best examples of camouflage are to be found among the insects. Many butterflies, although they may be brightly coloured on the upper side of their wings, resemble leaves when at rest with their wings folded. Stick-insects and leaf-insects are other well-known examples. Several kinds of tree-hoppers are almost indistinguishable from thorns when they sit on appropriate twigs.

Some camouflage is much less elaborate than this, relying simply on similar coloration to the surroundings. Polar bears, for example, blend well into the background of snow. Some moths closely resemble the colour of the tree-bark on which they

Varieties of Camouflage.

Countershading. The top animal is plain-coloured and shadows appear underneath. The shadows are countered by the pale underside of the bottom animal and, at a distance, it disappears.

Some creatures have an irregular silhouette which makes them less conspicuous. The Moloch or Thorny Devil comes from Australia.



Some animals can change colour to match their surroundings.

Man has learnt from animals how to camouflage himself and his buildings. Uniforms of khaki mean that soldiers blend in with vegetation, while the outlines of vehicles and buildings are blurred when they are painted in broad light and dark patches.

live. Some animals such as prawns and chameleons can even change the colour of their bodies to match their background.

Camping is an inexpensive way to spend a holiday and at the same time learn about nature. Camping means living under simple conditions out of doors. Campers use such shelters as tents, caravans or cabins—or, if conditions permit, they may sleep in the open. They cook their food over a campfire or on a portable stove.

In many places, organized camp grounds exist. In them, a family can have its own camp site, and share facilities for sanitation, laundry and swimming with other families. Many campers, however, prefer to stay completely on their own. Hikers carry all the things they need in packs on their backs, and walk for miles into the mountains or other remote places. Boy Scouts, Girl Guides, and various camping clubs sponsor regular outings for their members.

Successful camping requires the proper equipment, including a pocket knife, a hatchet or axe, a torch, a first-aid kit, simple equipment for cooking and eating, matches, and sleeping bag or blankets. With a little resourcefulness, almost everything else can be found or made. For example, sticks tied together with rope and supported between two trees make an excellent table.

It is also important to have some basic skills, such as knowing how to lay a fire and to tie secure knots. Similarly, it is useful to have some country lore—for example, to be able to identify poisonous plants and to know that dry wood burns best, whereas green sticks make good cooking utensils.

To prevent forest fires, campers must make sure fires are completely out before

Some of the many different kinds of tents which can be bought. In the centre are a bell tent and a 'pup' tent, both very simple. Others have side walls, inner partitions, and extensions giving extra space. Some are inflatable, needing no guy ropes, and some are fitted on to trailers.

moving on. Another important safety precaution is not to drink river water unless it has been boiled or purified with chemicals.

Canada is a huge country in the northern part of North America. Of all the countries in the world, only Russia is bigger. The Pacific Ocean and Alaska border Canada to the west. The Arctic Ocean lies to the north, the Atlantic Ocean to the east, and the United States to the south. Canada is a member of the Commonwealth.

Two mountain ranges form the western part of Canada. Close to the Pacific lie the Coast Ranges, rising more than 9,000 feet above sea level. They slope steeply to the sea, and their swift rivers are full of salmon. The coastline is jagged with many islands and fjords.

The Rocky Mountains lie east of the Coast Ranges. Much of the Rockies lies more than 6,000 feet high, with peaks over 12,000 feet. Thick forests cover much of the area. Several parts have been made into national parks.

Prairie land extends east from the Rockies. Huge wheat farms cover a great part of the area, which has warm summers and very cold winters.

The Canadian Shield is a flat area of low hills running from east of the prairies in a half-moon shape around Hudson Bay to the uplands of Quebec and Labrador. Many rivers flow north and south from

Canada is a country of contrasts. In the French-speaking areas, road signs are written in both English and French. Besides the English and French settlers, many other European minority groups migrated to Canada. In Manitoba, there are communities of Ukrainians who have retained much of their original culture. They are Orthodox Christians and have built churches out of wood that have the characteristic Russian 'onion shaped' spires. In a country as large as Canada there are some strange geographical features. In New Brunswick there is 'Magnetic' Hill. This is a slope that, because of the lie of the land, appears to go uphill, but which, in fact is a downward slope.

this area, and there are many lakes. Summers are short and warm, winters cold and hard.

The St. Lawrence Lowlands is the area bordering the Great Lakes and the St. Lawrence River, which lie between Canada and the United States. The soil is fertile, and farmers rear cattle and grow fruit and vegetables. Many of Canada's biggest cities are in this area, and two-thirds of its people live here. Ocean-going ships can travel up the St. Lawrence to ports on the shores of the Great Lakes. (See Great Lakes.)

The Atlantic Coastlands are the eastern-most part of Canada. Farmers grow crops in the fertile southern area.

The northern part of Canada is under snow for much of the year, and the sub-soil is permanently frozen.

Canada is rich in animal life. Grizzly bears live in the western mountains, polar bears in the Arctic regions and brown bears in many other areas. Deer, musk-oxen, caribou, beavers, foxes, skunks and wolves are some of the other kinds of animals found in Canada. Trappers hunt many animals for their fur.

The country is rich in many kinds of minerals, particularly asbestos, coal, gold, iron, natural gas, petroleum, platinum and uranium. Its many rivers provide hydro-electric power.

The forests of Canada have led to the development of its leading industry—making wood-pulp and paper. Mining, processing of metals and automobile manufacture are also important industries.

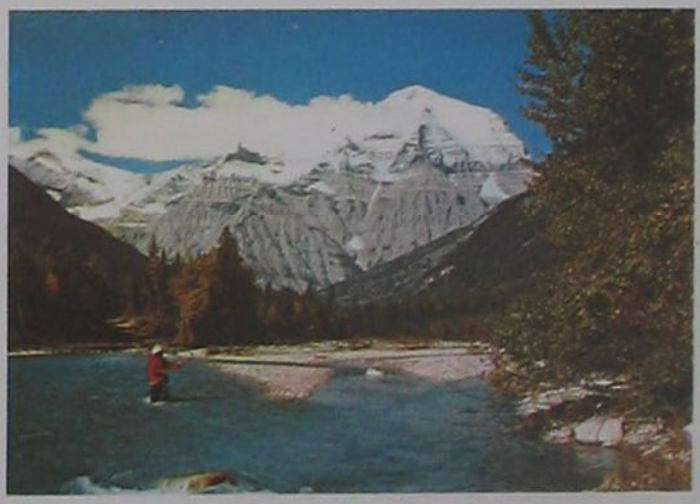
Nearly half the people of Canada are of British origin, and nearly one-third of French origin. Both English and French are spoken. Almost all the people are Christians and two-fifths of them are Roman Catholics.

Canada is a monarchy. The British sovereign is also queen of Canada, but the country is completely independent. Each of its 10 provinces has its own parliament and government. The people also elect a federal or central parliament

Above: Cattle ranching in Canada. Cowboys in Alberta.

Below: Fishing. All the lakes in Canada would form an area greater than that of France.

Bottom: The waterfront of Toronto, the second largest city of Canada. Toronto lies at the edge of Lake Ontario.



PROVINCES AND TERRITORIES OF CANADA

Province or Territory	*Area (sq. mi.)*	*Population*	*Capital*
Alberta	255,285	1,593,000	Edmonton
British Columbia	366,255	2,128,000	Victoria
Manitoba	251,000	981,000	Winnipeg
New Brunswick	28,354	623,000	Fredericton
Newfoundland	156,185	517,000	St. John's
Northwest Territories	1,304,903	33,000	Yellowknife
Nova Scotia	21,425	765,000	Halifax
Ontario	412,582	7,611,000	Toronto
Prince Edward Island	2,184	109,000	Charlottetown
Quebec	594,860	6,005,000	Quebec
Saskatchewan	251,700	943,000	Regina
Yukon Territory	207,076	16,000	Whitehorse

Annual Amount of Snow in Inches.

The whole of Canada has over 20 inches of snow a year, with the heaviest falls in the eastern part. Canadian winters are long and cold, temperatures everywhere being below freezing point except along the west coast.

The Relief Divisions of Canada.

Most of the Canadian Shield has been swept bare of its soil by the glaciers of the last ice age, and in the west are high mountain ranges which, like the Shield, are also unsuitable for agriculture. However, a layer of fertile soil covers the south-western plains, making this Canada's great wheat-growing region.

which makes laws for the whole country. The federal government also handles Canada's relations with other countries.

The provinces are Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan.

Two other areas, the Northwest Territories and Yukon Territory, have separate governments with fewer powers than those of the provinces.

American Indians, Eskimos and Aleuts were the first known inhabitants of Canada. The first known Europeans in Canada were the Norsemen from Scandinavia. They sailed along eastern Canada in about A.D. 1000. In 1497, the explorer John Cabot sailed from England to Canada on behalf of England. Historians believe that he landed in what is now Newfoundland. The French soon followed the English, establishing a fur trade with the Indians of the eastern coast. In 1608, the French explorer Samuel de Champlain established a settlement which later became the town of Quebec. The French extended their influence, and in 1663 made Canada a province of France. Already disputes had developed between the French of the St Lawrence River region and British traders who were established around Nova Scotia and Hudson Bay. Fighting occurred, which developed into war. In 1759, British forces under General James Wolfe captured Quebec, although he was mortally wounded in the attack. In 1763 France surrendered its Canadian possessions to Britain in the Treaty of Paris.

Although all Canada came under British rule, most people in the Quebec region were French-speaking Roman Catholics. The position of the French Canadians became intolerable, because British law at that time did not allow Roman Catholics to hold public office or to vote. Later, by the Quebec Act of 1774, Britain guaranteed the French Canadians religious freedom. The French system of

A display by the Royal Canadian Mounted Police, 'the Mounties'. They have been the national police force of Canada since the 1870's.

civil law was introduced alongside English criminal law.

As a result of the American War of Independence (1775-1782), many colonists loyal to Britain moved north of the border and settled in Nova Scotia and Quebec. Soon, Nova Scotia was divided, and in 1784 the province of New Brunswick was created. In 1791, the area around the St Lawrence River was divided into two provinces. One, Upper Canada (which later became Ontario), was mainly British. The other, Lower Canada (which later became Quebec), remained largely French.

During the late 1700's, explorers and traders pushed deeper into western Canada. During the early 1800's, British fur traders extended their operations to the Pacific Ocean.

In 1812, Britain and the United States fought a short war, and British and Canadian troops invaded the United States. In 1818, the boundary between Canada and the United States was established. It

Left: Ontario. In the foreground a workman is shifting pulpwood logs. Behind him a ship is taking on grain beside huge grain elevators.

Facts and Figures
Area: 3,851,809 square miles.
Population: 21,324,000.
Capital: Ottawa.
Money Unit: Canadian dollar.
Labour force: 70% urban; 30% rural.
Exports: metals, paper, timber, wheat.
Imports: machinery, petroleum, steel.

Above: Loading iron ore at Seven Sisters on the St. Lawrence.

extended from the Lake of the Woods in the east to the Rocky Mountains in the west. Oregon was to be jointly occupied for 10 years.

The colonists became dissatisfied with the system for government in the 1820's. They felt that the officials, who were chosen for life, did not govern in the best interests of the colonists. In Lower Canada, disagreements between French and British colonists continued, and in 1837 there were two uprisings. These led the British government to send Lord Durham to Canada to investigate. As a result of his report, the two Canadas were combined in 1840 and the colonists were granted limited self-government. In 1867, Nova Scotia, New Brunswick, Quebec and Ontario combined to form the Dominion of Canada. Sir John A. Macdonald was the first prime minister.

The Dominion expanded to include the province of Manitoba in 1870. British Columbia, which had been established in 1858, and which by 1866 included Vancouver Island, joined the Dominion in 1871. Prince Edward Island joined the Dominion in 1873, and Alberta and Saskatchewan in 1905. In 1948, Newfoundland became the tenth province.

By 1885 the Canadian Pacific Railway was completed, crossing the country from the east coast to the west. With the coming of the railway agriculture and small industries began to develop.

After World War II, Canada became increasingly involved in international affairs. It helped to found the North Atlantic Treaty Organization (NATO) in

1949. Canadian industry rapidly developed, particularly in nuclear power. In the late 1960's, French Canadians in Quebec demanded more self-government and sought closer ties with France. In 1969 French became the second official language.

Talking points

* Two nations colonized Canada. What problems has this led to?
* What influence has the climate had on the distribution of Canada's population and on its economy?
* Canada is a member of the Commonwealth and a neighbour of the U.S.A. Which do you think has had the greater influence on it?

Articles to read

See cities and provinces of Canada. *Also:* Cartier; Commonwealth; Montcalm; Northwest Passage; St Lawrence Seaway; Wolfe.

Canals Man has used rivers as a means of transporting goods for thousands of years. But the rivers did not always flow where he wanted to go. And so he built artificial waterways, or *canals*, linking one river with another, with a lake, or with the sea. Canals have other uses too. In hot countries, they provide water for irrigation. In low-lying countries, they help to drain the land. They are also used for fishing and pleasure cruising.

Inland canals achieved their greatest importance, especially in Britain, in the 1700's and 1800's at the time of the Industrial Revolution. They were developed to speed up the supplies of coal and other raw materials to the factories. With the rise of railway and later road transport, inland waterways declined in importance. But in some countries, such as The Netherlands, canals are still vitally important to trade, and are a major part of the transport system.

The most important canals today are the great ship canals, such as Suez and Panama, which provide short cuts on the world's shipping routes. The Suez Canal (opened in 1896) in Egypt links the Mediterranean and Red Seas, although it has been closed since the Arab-Israeli war in 1967. The Panama Canal (opened in 1914) in central America links the Atlantic and Pacific Oceans. The St. Lawrence Seaway (opened in 1959) opened up the Great Lakes to ocean-going vessels from the North Atlantic.

Building canals is similar in many ways to building roads, but the problem with canals is that unlike roads, they must

The Panama Canal was built during the early 1900's. The thousands of men who built it had to move 211 million cubic yards of earth and rock, using steam shovels and dredges. Many died from tropical diseases as they carved their way through hills, jungles, and swamps. This picture shows one of the great locks needed to raise ships across the central hills.

always be built on the level. They must go up and down slopes in a series of horizontal steps.

In most canals, a vessel passes from one level to another through a *lock*, which is a chamber with watertight gates at each end. Water can be pumped into or out of the lock to raise or lower vessels from one level to another. But in some canals enormous *lifts* move the vessels up or down in a water-filled chamber.

In the past, vessels were towed through canals by men or animals walking along a towpath. Today, they generally pass through under their own power. In some canals, such as Panama, they are towed through the locks by electric locomotives.

Canary Islands are 13 mountainous islands lying 60 miles off the Moroccan coast in the Atlantic Ocean. They are part of Spain. Their total area is 2,808 sq. miles, and their population 944,448.

Las Palmas and Santa Cruz de Tenerife are the main ports. Bananas, tomatoes and potatoes are exported. Fishing boats bring in tuna, sardines and shellfish, and ships call to refuel. Tourists enjoy the mild winter weather.

This map shows the location of the Canary Islands.

Canberra (pop. 139,800), the capital city of Australia, lies in the Australian Capital Territory, which is located in the south-eastern part of New South Wales. The site was chosen in 1909 and the carefully planned city was designed as a centre for culture and learning as well as government.

Canberra has an area of 12 sq. miles, and is laid out in the shape of a triangle. The Molonglo River flows through it. In the centre, the river has been dammed to form Lake Burley Griffin, named after the American architect, Walter Burley Griffin, who designed the city. Two bridges cross the lake.

The Parliament House and other government buildings lie on the southern

Civic Centre is the main business and shopping area of Canberra, Australia's federal capital. It lies beside the Molongo River and was planned early this century by the American architect Walter Burley Griffin.

Today's modern lightweight canoes are descended from light craft used since ancient times by peoples all over the world on inland waters.

bank. The Civic Centre, City Hall, Australian National University and Australian War Memorial lie on the northern bank. Residential suburbs fan out on both sides.

The people of Canberra work mainly in government offices, or in restaurants, hotels, shops, laundries and so on. The city has few industries. Road and air transport connect the capital with Melbourne and Sydney.

The Parliament House was officially opened in 1927, but some of the government offices remained in Melbourne until after World War II. Work began in 1965 on the building of a new Parliament House.

Candles have been used as a source of light since ancient times. They are still widely used in religious rituals, and for decoration in houses and restaurants.

During medieval times *tallow* candles, made by dipping wicks in animal suet, were common in Europe. Beeswax candles were more expensive. In the 1800's new materials were used—first *spermaceti* from whale oil and later *stearin,* manufactured from tallow, and *paraffin,* a mineral wax.

Canoeing is boating in canoes—small streamlined craft that are fast and lightweight, though easily tipped over. In prehistoric times, canoeing was an important means of transport, and it still is for primitive peoples in parts of the world where there are large rivers. But in de-

veloped societies, canoeing has become merely a sport and a means of relaxation.

Primitive canoes vary in design and materials. *Dugouts*, made by hollowing out trees, are used by some American Indians. Canoes of birch-bark stretched on wood are used by others. The Indians propel their canoes with single-bladed paddles. Eskimos stretch seal-skins over whalebone or wood frames to make *kayaks*. These canoes are completely covered except where the paddler sits. The paddle has a blade at each end. *Outriggers*, used in the South Seas, have floats attached to give the craft balance.

Canoes used in sport are made of wood, canvas over wood, aluminium, or fibreglass. Some of them are open (called *Canadian canoes*) and others are kayaks. A canoe race is a fast event, especially on a *slalom* (winding) or down-river course.

Associations and clubs to foster canoeing were established in Europe and North America in the 1800's. World championships and Olympic competitions began in the 1930's.

Canterbury is the largest province of New Zealand's South Island. Christchurch, its chief city, has a seaport nearby at Lyttleton. Other cities are Timaru, which is also a port, and Ashburton. The University of Canterbury, in Christchurch, is noted for its fine schools of law and engineering.

In the east, where most of the province's 376,441 people live, is the flat Canterbury Plain. On this side, there are magnificent beaches on the Pacific Ocean as well as productive farmland. In the west, the land rises to the majestic Southern Alps, with several peaks above 10,000 feet. The Mount Cook National Park is a famous area for winter recreation. Many rivers run down from the highlands and provide hydroelectric power.

Farmers in Canterbury grow grain, fruit, vegetables and animal fodder. They also raise dairy and meat cattle. Sheep graze in the foothills. Fishing fleets bring in their catches from the waters of the Pacific. Forests of pine trees feed a busy lumbering industry.

Canterbury's chief industries are those that process its agricultural products. There are many flour mills and meat-packing plants, and there are also clothing factories and factories producing tyres and engineering goods.

Cape Horn is the most southerly point of South America. It is a part of Horn Island in the Tierra del Fuego group of islands off the coast of Chile.

The first European to discover Cape Horn and sail around it was a Dutch sailor, Willem Schouten, on January 29, 1616. He named the Cape after Hoorn, his birthplace in the Netherlands. Because of the stormy weather and powerful currents, sailing around Cape Horn, or 'rounding the Horn' as it is called, was very dangerous for sailing ships. After the opening of the Panama Canal, most ships sailing between the Atlantic and Pacific oceans avoided Cape Horn.

Cape of Good Hope is one of the most southerly points in Africa. It is a hook shaped peninsula extending into the Atlantic Ocean 92 miles north-west of Cape Agulhas, the extreme tip of the continent.

Bartolomew Diaz, a Portuguese navigator, discovered the Cape of Storms, as he called it, in 1488. The king changed the name because he hoped Diaz had found a sea route to the East. In 1497, Vasco da Gama rounded the Cape and continued on to India.

Cape Province, at the southern tip of Africa, is South Africa's largest province. Its area is 278,465 sq. miles. The provincial

Few ships round Cape Horn since the building of the Panama Canal. But today it is one of the most challenging parts of the journey of solo sailors like the late Sir Francis Chichester in their voyages round the world.

Cape Town. Table Mountain in the background is covered by its 'Cloth'.

capital, Cape Town, is also the national capital where South Africa's parliament meets.

The province has 5,360,234 people, and Bantus outnumber Europeans three to one. More than a million *coloureds* (people of mixed descent) also live there. The principal cities are the ports: Cape Town, Port Elizabeth and East London. Kimberley is an important inland city in a diamond-mining region.

Cape Province is mostly a grass-covered plateau with the Nieuweld, Swartberg and Langeberg ranges rising above it. Because many parts are semi-desert, irrigation is necessary for farming. Farmers grow wheat, maize, citrus fruits, grapes and tobacco. Large numbers of sheep are raised for wool. Factories produce motor vehicles, cloth, leather goods and tinned foods. Besides diamonds, copper is mined.

Cape Town began as a Dutch supply station. Later, French Huguenots arrived. Britain annexed the Cape of Good Hope Colony, as it was called, in 1806.

Cape Town, the second largest city in South Africa, is a port and the capital of Cape Province. It is also the *legislative* (law-making) capital of the Republic of South Africa. The administrative offices of the Republic government are in Pretoria. With its suburbs, Cape Town has a population of about 800,000. The city is dominated by Table Mountain, and lies on the south-west coast of Africa.

The city was founded in 1652 as a supply base for ships going to and from the East. Its excellent harbour has made it an important trading centre. Its importance in east-west trade grew once again after the Suez Canal was closed because of the Middle East war in 1967.

Cape Verde Islands, a group of 15 islands in the Atlantic Ocean, form an overseas province of Portugal. They lie about 300 miles off the coast of Senegal, in western Africa. The capital city of the Cape Verde

Islands is Praia, on Sao Tiago, which is the largest island. Mindelo, on Sao Vincente, is a port of call for ships travelling between Europe, South America and southern Africa. The total area is 1,560 sq. miles, and the population 260,000.

The mountainous islands were formed by volcanoes, one of which is still active. Despite the hot and dry climate, most people are farmers. Generally they grow just enough for their own needs, but some coffee is exported. Other exports include oranges, hides, mustard and tobacco. Fishermen catch tuna for canning and cod to be preserved in salt. There are salt pans on some of the islands.

Portuguese navigators discovered the Cape Verde Islands in the mid 1400's. The islands were soon settled by Portuguese convicts and slaves brought from West Africa to work on plantations. They grew in importance with the slave trade and declined after slavery was abolished in 1876. Frequent droughts caused many islanders to leave. Most inhabitants are Negroes, descended from slaves, or *mulattoes* (people of mixed descent).

This carpet factory represents capital, though the land on which it is built does not.

Capital Money, equipment, and other assets which result from man's thought and work and which are used to produce further assets are called *capital*. Land is not capital, because it is not produced by man, but a factory built on the land is.

Money used to buy food, household furniture, or other *consumer goods* (goods that are used up and are not used to produce more things) is not capital, but if it is used to buy seeds or fertilizer, or to buy machinery to make furniture, it is capital. Sometimes, the same objects may be both consumer goods and capital. For example, vehicles used for pleasure are consumer goods, but if a person uses his private car for business it is also capital because it helps to produce income for the business.

Capitalism is a term used for an economic system in which the ownership and direction of business enterprises rests with private individuals or companies not controlled by the government.

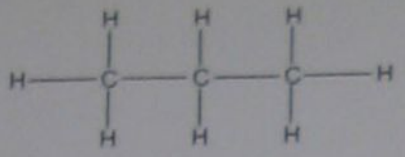
Capital punishment is the punishment of criminals by putting them to death. Once, criminals were executed even for some minor crimes. But today many countries have abolished capital punishment completely. And those that have kept it generally execute only persons who are convicted of the most serious crimes, such as murder.

Some people support capital punishment because they believe in taking 'an eye for an eye: a tooth for a tooth'. Others say it saves innocent lives by deterring some persons who might otherwise commit murder. Still others say that society should not have to pay for alternative, more expensive punishments, such as life imprisonment.

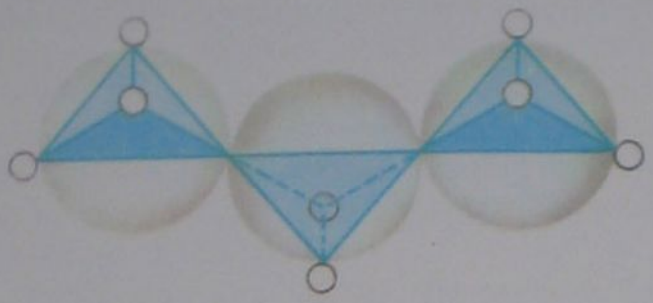
Opponents of capital punishment say that it is barbaric, and degrades civilized society. And a person wrongly convicted and executed cannot be brought back to life. They claim that statistics prove crime does not increase when capital punishment is abolished.

Caravan is a house on wheels, towed behind a car or other vehicle. Most caravans are designed for use as living quarters during travel or when camping. But in some countries, people whose jobs require frequent moves live permanently in caravans instead of ordinary houses. Retired people sometimes live

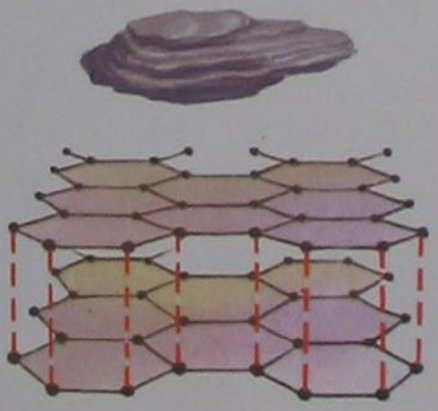
Opposite: A barrel-shaped horse-drawn caravan in County Wicklow, Ireland.



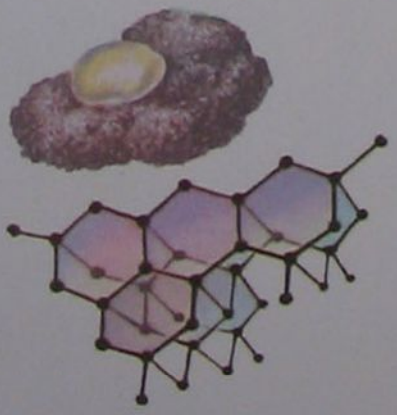
The simplest way of representing a carbon chain. C stands for an atom of carbon; H stands for an atom of hydrogen.



A more detailed representation of the same carbon chain. Each pyramid stands for an atom of carbon and each white ball for an atom of hydrogen.



Carbon atoms in a graphite crystal are arranged in sheets. Strong bonds link the atoms within each sheet, but the bonds between atoms in adjacent sheets are weak.



Each carbon atom in a diamond is joined to four neighbours by strong bonds.

in caravans so that they have freedom to move about as they please. Gypsies also live in caravans. Nowadays they use modern motor trailers, but once they were famous for their gaily painted, horse-drawn homes.

Camping caravans are better than tents as shelters. They usually contain sleeping berths and a dining area, and are fitted with a refrigerator and a stove (which runs on butane gas).

Caravans for living in may be 50 feet or more in length, and are sometimes quite luxurious, with a sitting room, bedrooms, a dining room and a bathroom. They are furnished just like ordinary homes. Caravans can stop at special caravan parks or sites, where they can be connected to water and electricity supplies.

Carbon The most prized gem *diamond* is the hardest substance in Nature. *Graphite* is one of the softest. Yet they are both natural forms of the same chemical element—carbon.

The difference lies in their crystal structures. Diamond forms strong, glittering, transparent crystals. Graphite crystallizes in black flakes, which can slip over one another easily. This makes graphite feel 'greasy', and it is in fact used to lubricate machinery. Mixed with clay, it forms the 'lead' in pencils.

One of the most familiar forms of carbon is *coke*, which is manufactured by heating coal without air. *Charcoal* is a pure carbon made from wood in a similar way. These two forms appear *amorphous* (shapeless) not crystalline.

When carbon burns, it forms carbon dioxide, and a lot of heat is produced. All our natural fuels—coal, petroleum, natural gas, and wood—contain large amounts of carbon in compounds with other elements.

Carbon gives rise to a greater number of chemical compounds than any other element. This is because its atoms will combine not only with the atoms of other elements but also with themselves. They

Diamonds are the hardest substance in nature. They are not always used as jewellery. Some, called 'commercial' diamonds, are used in cutting tools.

form molecules in an almost endless variety of forms—long chains, complicated networks, and rings.

It is such complex carbon compounds that form the basis of all living things, animals and plants alike. The study of carbon compounds forms a complete branch of chemistry called *organic chemistry*, 'organic' referring to 'living'.

Some complicated organic compounds in living things are built up from a very simple one—carbon dioxide. Animals cannot use the gas directly. But plants can, and they turn it into more complex compounds, which animals eat as food. The animals' bodies use this food as a starting point to build up their own incredibly complex organic compounds.

Man, too, can build up large organic molecules from smaller ones in his chemical plants. Plastics, dyes, drugs, synthetic fibres and detergents are all man-made products built up in this way.

Carbon dioxide is produced when carbon burns in plenty of air. A small but vital amount is present in the air around us. Plants need carbon dioxide in order to live. They use it to make food. At the same time, they give off oxygen. Animals, on the other hand, need oxygen to live and give off carbon dioxide through their breath.

Carbon dioxide is not poisonous but, breathed in large quantities, it will cause suffocation. It is heavier than air and will extinguish flame. This makes it valuable in fire extinguishers.

Carbon dioxide is the gas that gives the sparkle to soda water and other drinks. It is forced into the liquid under pressure.

Carbon monoxide is formed when carbon burns in a limited supply of air. It is a poisonous gas and is doubly dangerous because it has no colour or smell. Breathing in even small amounts prevents oxygen getting into the blood. Automobile exhaust fumes contain enough carbon monoxide to become dangerous if they

If carbon dioxide gas is bubbled through a clear solution of calcium hydroxide, the liquid becomes cloudy due to the formation of white grains of calcium carbonate. Exhaled air contains carbon dioxide.

Carbon dioxide is set free if dilute hydrochloric acid is poured on to marble (calcium carbonate) or other metallic carbonates.

A card game in a fashionable drawing room, 1820. Up to about this period gambling was considered a gentlemanly occupation, and in the 1700's large numbers of people lost huge amounts at cards.

are allowed to build up. For this reason, automobiles should never be left running in a closed garage.

Carbon monoxide burns with a blue flame and is one of the gases in coal gas.

Card games Many games can be played with the conventional pack of 52 playing cards which is divided into four suits: spades, hearts, diamonds and clubs. Each suit contains thirteen cards. Most games use the whole pack and in some a separate Joker card is used.

There are countless forms of Patience, a solitary game in which the player starts with a pattern, and then by a series of regulated moves attempts to sort out all the cards in order, perhaps in separate suits and ascending and descending order. In games like Piquet, Bezique and Cribbage, two opposing players attempt to arrange their hands in certain scoring combinations.

Tricks and Trumps are the basis of Whist, for some 400 years a popular game for four players paired as partners. Each player is dealt 13 cards and play proceeds in a clockwise direction. Each player must follow suit if possible, but if he cannot he may use a card of the suit declared as 'trumps' or any other card. The highest trump card, or the highest card of the suit led, takes the trick. Bridge is a development of Whist involving bidding for the right to play each hand, and the exposure, face-up, of the cards belonging to the declarer's partner.

In the skilful game of Poker, as in Rummy, the object is to assemble certain combinations of cards. In another group of games, players are required either to get rid of their cards, or collect the greatest number.

The origin of playing cards is uncertain. They probably originated in China, but were introduced into England from France during the 15th century.

Cardiff, capital of Wales, stands at the mouth of the River Taff, in Glamorganshire. Its population is 278,221.

Cardiff is the port of the South Wales coalfields. Its many industries include shipping, coal, flour-milling, engineering, paper-making, enamelware and building materials. It houses the University College

of South Wales, and also the cathedral of Llandaff.

Cardiff dates from Roman times. Its prosperity in the late 1800's and early 1900's was built on coal exports. It was named capital of Wales in 1955.

Cardiganshire, a mountainous Welsh county, faces Cardigan Bay, in the Irish Sea. Its county town is Cardigan, and its area is 693 square miles.

The land is largely unspoilt, and rises to a peak of 2,468 feet at Plynlimmon, in the extreme north-east. The rivers that drain the county are the Dovey, Teifi, Ystwyth and Rheidol. Sheep-rearing and salmon-fishing are the main occupations, and there is some agriculture. The most important town is Aberystwyth, which houses the University of Wales. Lampeter has a well known theological college.

Caribbean Sea is a large, tropical basin of the Atlantic Ocean. It is bounded by the Yucatan Peninsula of Mexico, Central America, the northern coast of South America, and the islands of the Greater and Lesser Antilles in the West Indies.

The Caribbean is smaller and deeper than the Mediterranean. It is some 1,700 miles from east to west, and between 400 and 800 miles from north to south. Its deepest point is 22,788 feet below sea level in the Cayman Sea, between Cuba and Jamaica.

The Caribbean's beautiful beaches and blue water make it a favourite resort area. The temperature is always warm, and a gentle breeze blows from the north-east. From August to October, however, fierce hurricanes can occur.

The Caribbean is crossed daily by ships carrying the region's riches to other parts of the world: sugar cane, bananas, cacao beans and coffee; iron ore and oil from Venezuela; bauxite (aluminium ore) from Jamaica.

The Panama Canal links the Caribbean with the Pacific Ocean, making the west

This boy, like many of the people who live in the Caribbean islands today, is descended from Africans brought over to work on the sugar plantations as slaves.

coasts of North and South America easily accessible. The canal, built by the United States, was opened in 1914.

Christopher Columbus reached the Caribbean on his first Atlantic voyage in 1492. As a result of this visit and of later explorations, Spain claimed the entire area. But the Lesser Antilles were acquired by the French, British, Dutch and Danes in the 1600's. Santo Domingo on the island of Hispaniola was the first permanent Spanish settlement.

The Spaniards found fabulous treasures of gold and silver in their new territories, and their fleets carried the riches back to Spain. The *Spanish Main* (short for *Spanish Mainland,* meaning the coast of South America) and the Caribbean Sea soon became the haunt of pirates of many nations seeking to cash in on the booty.

The Spaniards at first tried to enslave the region's native Indians, including the fierce Caribs, but failed and slaughtered many of them. Then they began importing Negro slaves from Africa, who were set to work in sugar cane plantations. Soon other nations began taking part in this profitable business, and a thriving triangular trade route developed between the New World, Europe, and Africa.

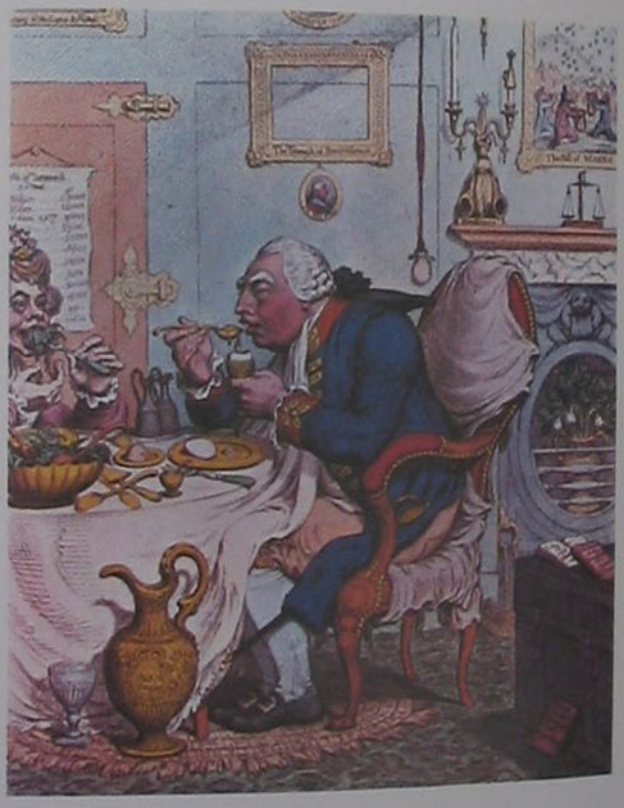
The Spanish hold on the Caribbean eventually weakened. One by one, independent nations formed. Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Colombia, the Dominican Republic and Venezuela had broken away from Spain by 1821. France, which had seized Haiti in 1697, lost it in 1804.

The Spanish-American War made Cuba independent in 1898, and gave Puerto Rico to the United States. Panama staged a successful revolution against Colombia in 1903. Jamaica, held by Britain since 1655, became independent in 1962. Other formerly British countries are Barbados and Trinidad and Tobago.

Carib Indians were tribal people who once inhabited the region around the Caribbean Sea. They were savage warriors, and were cannibals who ate the enemies they captured.

The Caribs lived in small villages in the tropical forests. They painted and decorated their bodies, possibly in imitation of bright jungle birds. They grew some root crops, and ate fish and forest animals caught with blowguns and poisoned arrows. In their dugout canoes, they travelled widely in the Caribbean Sea.

The Caribs were living on the islands of the Lesser Antilles when Columbus landed there. They had gone to the Antilles from northern South America and had defeated the more peaceful natives, the Arawak Indians. The European settlers, who began to arrive in the 1600's, nearly wiped them out, and today only a few survive in reservations.



This late 18th-century caricature by Gillray pokes cruel fun at King George III and Queen Charlotte.

Caricature is a distorted picture of a person, intended to be humorous, satirical, or insulting. Most caricatures are drawings, but there are also caricatures in writing—for example some of the plays of Aristophanes in ancient Greece. The

caricaturist usually exaggerates an easily recognized feature of the subject's appearance or habits, such as a large nose, bushy eyebrows, an unfriendly expression or a distinctive way of dressing.

Political leaders are constantly caricatured in cartoons that appear in newspapers and magazines. These caricatures are intended as comments on political events, and they may show politicians as praiseworthy, ridiculous or even evil.

Modern caricature drawing developed first in Italy and France during the Renaissance and later spread to Britain. William Hogarth and Thomas Rowlandson aptly portrayed the foibles and pretentions of various people in England in the 1700's and 1800's. In France, Honoré Daumier gave such offence by his caricatures of the king and other public figures in the 1830's that he was imprisoned.

Carmarthenshire, the largest county in Wales, borders the Bristol Channel in the south. Its county town is Carmarthen, and its area is 919 square miles.

Carmarthenshire is a fertile, wooded county, mountainous in the north and east. Livestock is reared in the uplands. In the southern lowlands, farming and agriculture are the main pursuits. The Towy is the only important river. Anthracite seams in the south have encouraged coalmining and metalworking industries there. Tin and copper smelting, and tinplate manufacture, are major industries in Llanelli.

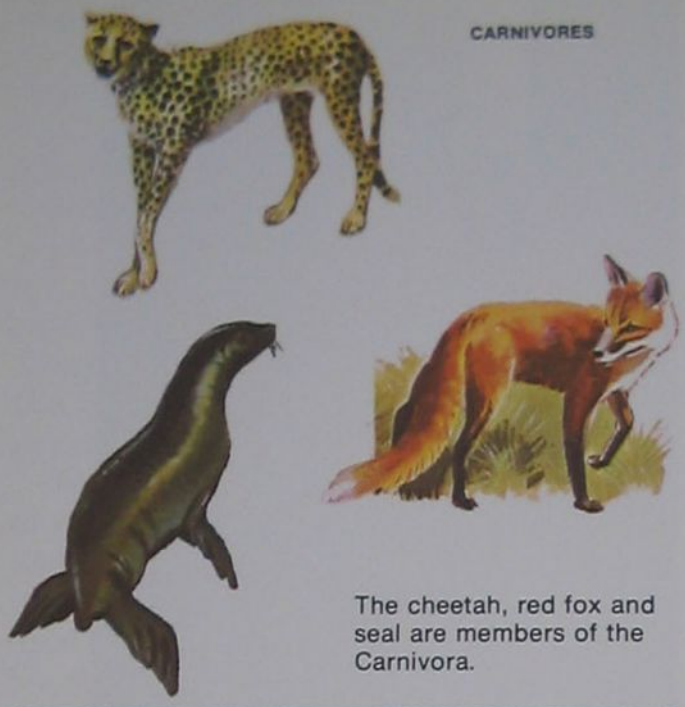
Carnegie, Andrew (1835-1919), an American industrialist who was born in Scotland, made an immense fortune as a steel manufacturer. In later life he used this money to finance schools, libraries and other worthwhile institutions because he believed that rich men held their money in trust for the public good.

Carnegie provided the money to build more than 2,000 public libraries in the United States, the United Kingdom, Canada and other countries. He founded scientific and art institutions, and gave large donations to bodies working for world peace.

Andrew Carnegie was born in Scotland and made his fortune in America. He used his money to found libraries, and support education and world peace.

Carnegie was born in Dunfermline, in Scotland. His family emigrated to Pennsylvania in the United States when he was 13. His first job as a boy was in a cotton factory.

Carnivore This is the name given to any animal that eats the flesh of other animals. Biologists use the term specifically for members of the Carnivora—one of the *orders* (major groups) of mammals. This order is divided into two sub-orders. The *Fissipedia*, or land carnivores, include the wolves and dogs, the cat family, bears,



The cheetah, red fox and seal are members of the Carnivora.

mongooses, and hyenas. Seals and walruses are sea-living carnivores and belong to the sub-order *Pinnipedia.*

Carpets add to the warmth and comfort of any home. They may be plain or patterned, white or multi-coloured to suit the decoration and furnishings in a room. Carpets extending all across the floor from wall to wall are called *fitted* carpets. They may be made out of strips joined together or out of a single width, called *broadloom.* They usually have a felt or rubber *underlay,* which makes them feel softer and last longer.

Most carpets are made up of a number of tufts of material which have been woven, threaded, or knotted into a firm fabric backing (usually jute). The tufts form the *pile* of the carpet. The backing is generally woven at the same time as the carpet. Wool is the traditional fibre for the pile yarn. But man-made fibres especially nylon, are also used, either alone or in blends with other fibres.

Most carpets are made on power looms similar to those used for weaving cloth. (See Textiles.) In the *Wilton* carpet, the pile is formed from warp yarn. This yarn is formed into loops and woven into the backing. Then the loops are cut

The finest eastern carpets have several hundreds of knots to the inch. At one time children were used to make them—only they had hands small enough to work in such fine detail.

to make the tufts of the pile. In a *cord* carpet, the loops remain uncut. *Axminster* carpets are made by cutting tufts for the pile first and then weaving them into the backing.

Tufted carpets are not woven like the others. The pile yarn is needled into the carpet backing to give a series of

Carpet weaving is a traditional industry in India and the Middle East. Hand-woven carpets are used as wall decorations as well as for covering floors. They are exported to the West where they fetch high prices. Right: A Lebanese woman weaves several colourful threads into a carpet on a simple loom. Intricate designs can be made by hand. Most carpets are woven by complex machines. Below: Lines of thread enter the machine to be woven together.

Ruined pillars of the ancient North African city of Carthage. Founded by Phoenician traders, it was eventually destroyed by Rome.

loops. The backing is then treated with a plastic or rubber compound to fix the loops. Then the tops of the loops are cut to make the pile.

Carroll, Lewis (1832-98), was the pen name of the English author Charles Lutwidge Dodgson. Dodgson taught mathematics at Christ Church College, Oxford. A shy man, he was most at ease with children, and one day he made up a story for a young girl called Alice Liddell and her sisters. In 1865 it was published as *Alice's Adventures in Wonderland*, and in 1872 he published a sequel, *Through the Looking Glass*. Both tell of Alice's strange adventures in dream-like worlds, the first peopled largely by the figures of a pack of cards and the second by those of a chess game. Both books were immensely successful, with adults as well as children, and were admired by Queen Victoria. *The Hunting of the Snark* (1876) was his most successful nonsense poem. Dodgson also published mathematical books.

Carson, Christopher 'Kit' (1809-68), was a famous American frontiersman. He was brought up in Missouri and at the age of 15 he worked his way to New Mexico on a waggon train. After several years trapping beavers for fur, he served as a guide for the military explorer John Fremont. During the Civil War he helped raise volunteers in New Mexico for the Union Army, and also fought against the Indians. He was made a general in 1865.

Carthage was on the north coast of Africa, south of modern Tunis. The city was founded by Phoenicians in the eighth century B.C. as a trading settlement. By the sixth century it had grown to be the centre of an empire. Carthaginian merchants and sailors planted new settlements in Sicily, Spain and North Africa. They tried to prevent the Greeks, and later the Romans, from trading in the

areas they controlled and this led to frequent wars. The Carthaginians were few in number. They could not man their trading fleets and defend their cities by themselves, so they employed Spaniards and Arabs to fight for them as mercenaries.

In 241 B.C. the first war with Rome ended in defeat for Carthage. The Romans built a fleet and took the war to sea as well as fighting on land. In 218 the Carthaginian general, Hannibal, attacked Rome in a new way. He marched from Spain through southern France, crossed the Alps and invaded Italy from the north. He won many victories; the battle of Cannae (216 B.C.) was Rome's worst defeat. But Hannibal could not capture Rome itself. Thirteen years after the invasion began he was forced to leave Italy. The Roman Scipio had sailed to Africa and forced Carthage to surrender in 203 B.C. A year later Scipio defeated Hannibal and the war ended. Fifty years later the Romans attacked and in 146 B.C. totally destroyed Carthage.

Cartier, Jacques (1491-1557), was a French explorer. Born in St Malo in Brittany, he was sent to North America in 1534 by King Francis I of France. His mission was to claim land for France, and to look for the fabled North-West Passage round the north of America to Asia.

Cartier never found the North-West Passage, but during three voyages he explored much of the coast of Canada. In 1535 he became the first European to sail up the St Lawrence River, with the help of Indian guides. He reached the site where Montreal now stands, but rapids stopped him getting any farther. Cartier was convinced that Canada would offer colonists great opportunities, and it was through him that much of the land was claimed for France.

Cartoon The word cartoon was first used to mean a drawing made as a preliminary design for a painting or tapestry. The famous Raphael cartoons and the tapestry for which they were prepared can be seen in the Victoria and Albert Museum in London. The term now also means a drawing in which exaggeration (especially of facial characteristics) is used to emphasize points, or to make the people depicted more readily recognizable.

Cartoons by Hogarth in the 18th century, for instance, were elaborate works of art which aimed to show up the faults and follies of English society of the time. In our day, most newspapers carry car-

Walt Disney made a great number of cartoon films that have delighted people all over the world. Most Disney cartoons featured figures that he created, such as Mickey Mouse and Donald Duck, but occasionally he made cartoon films of famous stories. In this scene from *Alice in Wonderland* by Lewis Carroll, the Mad Hatter is pouring a cup of tea at his tea party as Alice looks on with some concern.

One of the greatest of all wood carvers was the 17th-century Englishman Grinling Gibbons. This intricately detailed collection of musical instruments, leaves, jewels and lace is carved on panelling at Petworth House in Sussex.

toons which are comments on current political and social affairs. The word is also used to denote films made of animated drawings such as those of Walt Disney.

Carving is the technique of cutting figures or designs in ivory, wood or other materials. It is one of the oldest forms of art, going back to prehistoric times. Large carvings in marble or other stones are called *sculpture*.

Carvings have been made by people all over the world. In Africa, masks and small figures with simple lines are carved in dark woods, such as ebony. In China, people make carvings in ivory or jade, with intricate detail. American Indians carved totem poles to represent the animal spirits from which the tribes believed themselves descended. Carved stonework figures decorate the exteriors of churches throughout Europe. Inside, wood carvings adorn the choir stalls, altars, pews and doors. The Arabs made beautiful carved patterns to cover the walls and ceilings of their palaces.

The carver's tools depend on the material with which he is working. The most common tools are the hammer, chisel, gouge, drill and knife.

Caspian Sea This is the world's largest inland body of water. It is bordered by Russia and Iran (Persia) and has no outlets.

The Caspian Sea has an area of about 163,800 square miles. Several rivers, including the Russian Volga River, flow into the Caspian. But its area has been

Gondar Castle in Ethiopia was built by Emperor Fasilidas in 1632.

Opposite: Huge round towers fortify the walls of the great medieval castle of Angers in France.

shrinking for several hundred years. The shrinkage is caused by the great loss of water by evaporation. This loss exceeds the amount of water that flows into the Caspian. The shore of the Caspian is now more than 90 feet below sea level.

Castles have been used as defences against invaders since the early Iron Age in Europe and probably for much longer in Asia.

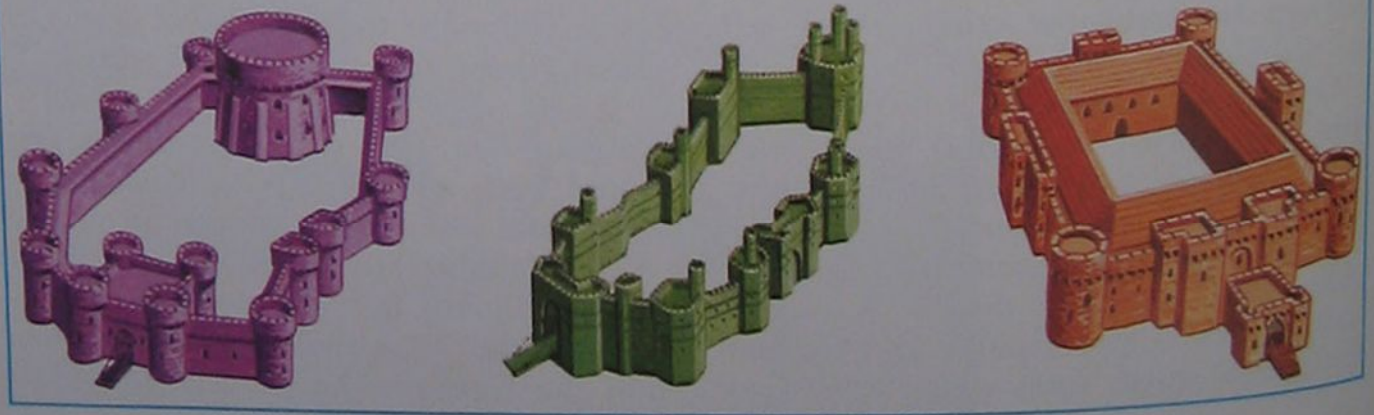
The defences of Iron Age castles were dug in the form of huge ditches and mounds of earth topped with a stockade which consisted of a stout fence of sharpened stakes. The mounds and ditches formed great circles, one inside the other, leaving a space in the middle large enough to keep stores of food, cattle, and the families from local settlements. Remains of these earthen castles can be seen at Badbury Rings and at Maiden Castle in Dorset.

Romans, guarding the shores of Britain, built castles of stone and concrete in squares based on the plan of their camps. One can still be seen at Pevensey, Sussex.

The Normans carried prefabricated castles with them on important campaigns. They took such a castle to Hastings when they invaded England in 1066. Local people were forced to dig a large roughly circular ditch, throwing the earth into the centre to form a steep-sided mound, or *motte*. Norman engineers then assembled prefabricated timbers to build a central tower, which stood within the *bailey*, or open courtyard, on top of the mound. Later they added a stockade on the inner side of the ditch.

After the Normans had overcome English resistance they ruled the country from a series of stone castles built on roughly the same plan as their motte and bailey castles. These stone castles were much more elaborate, however. They had stone walls of immense thickness, rising from a moat filled with water, pierced with slits through which bowmen could harass attackers, and strengthened at crucial points by projecting towers offering a field of fire along the length of the walls. There would be a strong

Left: In the 1100s, castles were built with strong round towers. Centre: After the Crusades, defence centred more on the outer walls, which were dominated by massive towers. Right: By the early 1300s, fine structures of concentric design were built. The invention of gunpowder made the castle obsolete for defence.



gatehouse under which the enemy would have to pass while being pelted with boulders and showered with boiling oil. Inside the walls there was sufficient space to graze a few cattle and raise vegetables, house the garrison, and build a chapel, before coming to the great *keep* which towered above the other defences. The well was often under the keep, and all the main stores and arms were housed there, together with the lord of the castle, his family and chief retainers.

Talking points

* Make a map of your neighbourhood and choose the best place to build a castle. Draw a plan of your castle, showing outer and inner defences, water supplies, etc.
* In the Second World War men again built fortified places in which to live and work. Can you give examples and think of other uses today for such buildings?
* Write a description of a castle under siege, bringing in as many weapons and methods of attack and defence as you can think of.

Articles to read

Architecture; Guns; Heraldry; Warfare.

Castro, Fidel (1927-), became prime minister of Cuba in February 1959, after his guerilla forces defeated the dictatorship of President Batista. Castro's government began a series of reforms in agriculture, industry and education. These policies were based on the communist theories of Marx and Lenin (see Lenin, Vladimir; Marx, Karl). In 1961, Cubans who had fled after Castro came to power landed in Cuba at the Bay of Pigs to try to overthrow Castro. This attempt was unsuccessful. Cuba became more dependent on aid from communist countries, chiefly from Russia. In 1962, America and the Soviet Union came near to war over missile bases that had been built in Cuba by the Soviet Union. However, the missile bases were removed.

Born in Oriente Province, Cuba, Castro trained and worked as a lawyer in Havana. He led an unsuccessful revolt in 1953. After a year's imprisonment, he went to Mexico. In 1956, Castro returned to Cuba with a small guerilla band, and from the Sierra Maestro mountains in southern Cuba began the campaign against Batista.

Catalysts are substances that effect chemical reactions without themselves being changed. Many catalysts either *initiate* (start) the reactions or speed them up. Chemists do not understand precisely why catalysts have these effects, but without them many industrial processes would be impossible because they would take too long or would require too high temperatures. Because catalysts come out of the reactions unchanged, only small amounts of them are needed.

If hydrogen and nitrogen are heated in the presence of powdered iron (which acts as a catalyst in this case) they will combine easily to form ammonia. In making nitric acid from ammonia, platinum is used as a catalyst. Catalysts are also used in making margarine from vegetable oil, and in refining petroleum. The digestive enzymes in our bodies are also catalysts. Some catalysts, called *negative catalysts*, slow down chemical reaction. Industrially, they can be used for such purposes as helping to prevent oxidation damage to metals.

A puss moth caterpillar raising its head in a threatening attitude.

Caterpillar This is the larva of a butterfly or a moth. Caterpillars hatch from eggs. They are worm-like creatures with a distinct head and 13 body segments. Three pairs of jointed legs are attached to the front three segments, and fleshy protuberances called *false legs* usually grow from four middle segments and one at the end of the body. 'Looper' caterpillars have only two pairs of false legs and they move by bending their bodies into loops.